One Community College Information Security Curriculum: Meeting Standards, Enhancing Student Employability, Facilitating Transfer to Four-Year Institutions, and Articulating with High Schools

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Author Note

This version is prepared for the 2014 Community College Cyber Summit at Moraine Valley Community College, Palos Hills, Illinois and is a work in progress as several of the standards that the curriculum reference are still in Draft status as of July, 2014.

Abstract

Community Colleges serve students with different educational goals. One result has been the segregation of courses and programs based on whether they serve an academic or career preparation focus. This paper details the development of an Information Security program with the goal of bridging this divide by creating a program that serves both needs.

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The responsibility for Community College curriculum and academic standards fall squarely on the shoulders of community college faculty. California Community College (CCC) governing boards are required by State statute to rely primarily on faculty for matters pertaining to curriculum and academic standards (Cal. Ed. Code § 70902(b)(7)**).** This authority comes with an abundance of competing interests, some of which are common among higher education institutions and others that are unique to a CCC. While this paper focuses on the details of crafting an Information Security (InfoSec) program within an existing Information Technology (IT) program at San Bernardino Valley College (SBVC), the broader aspects of curriculum and academic standards at CCCs is relevant and necessarily influence and inform the process and end product.

As should be expected within a collaborative and consensus driven organization such as a CCC, the approval of one or more committees is part of course and program creation. The SBVC campus-level activities culminate with the College-wide Curriculum Committee (Curriculum Committee), which operates under the authority of the Academic Senate. The Curriculum Committee provides gatekeeper and quality control functions simultaneously assisting and frustrating faculty as they seek to gain approval of their curriculum. SBVC has adopted CurricUNET a commercial Information System to mange the workflow associated with curriculum creation and maintenance. All of the curriculum discussed in this paper can be viewed online

(http://www.curricunet.com/sbvc) because the SBVC CurricUNET system does not require a login or password for simple view access.

Many factors are considered when creating a new academic program at SBVC. Among these are state and local mandates, student employment opportunities, SBVC student transfer to four-year institutions, and facilitating transfer of students from local high schools to SBVC. Each of these requirements is satisfied in the SBVC curriculum with the specifics of how this is accomplished discussed in the results section of this paper. The justification for making these four items essential is discussed in the Literature Review section of this paper.

Problem Statement

San Bernardino Valley College (SBVC) needs to create a program in Information Security (InfoSec) that simultaneously serves the needs of students who will be seeking employment immediately after graduation as well as those who will be transferring to a four-year institution. To serve this dual purpose, the curriculum must, (1) comply with state and local mandates, (2) afford students employment opportunities, (3) facilitate SBVC student transfer to four-year institutions, (4) enable local high school students to transfer to SBVC.

The remainder of this paper is organized in sections. The next section is a review of relevant literature, which is followed by a section that discusses the methods used to create the curriculum. The resulting SBVC curriculum is in the results section and this paper concludes with the analysis and conclusions section.

Literature Review

This section will discuss the academic foundation for the approach used based on published research studies. Peer-reviewed journals and conference proceedings are the most common source cited. Occasionally the type of information referenced is not what one would expect to find in peer-reviewed journals and in those cases credible sources are used. This section is arrange in subsections that correspond to the four basic curricular requirements, (1) state and local mandates, (2) employment opportunities, (3) transfer to four-year institutions, (4) high school transfers to SBVC.

State and Local Mandates

Transfer Degrees. The California Community Colleges (CCCs) are open access institutions with the mandate to serve any Californian who can benefit from instruction. Simultaneously serving students with aspirations to transfer to a four-year institution and those seeking employment without a bachelor's degree, CCCs have, since their inception, enjoyed both support and a level of suspicion by their State-funded 4-year academic cousins (Cooper, 1928). Cooper's observations, while almost a century old, represent a reality that is fundamentally unchanged. The University of California (UC) and the California State University (CSU) systems support CCCs while carefully vetting the content and rigor of courses offered by CCCs. Earlier efforts at facilitating student transfers from CCCs to CSU notwithstanding, California required CCCs to create degrees for transfer based on requirements approved by the CSU and the CCC Academic senates (Student Transfer Reform Act of 2013). The process for approving the content for an associate's degree for transfer is extensive and the ICT Associate of Science for Transfer degree (ICT AS-T) is still in a draft status.

Student Learning Outcomes. All SBVC courses and programs require student-learning outcomes (SLOs). SLOs are an effort to provide an accountability metric for colleges and universities and accreditation agency requirements are the primary factor driving institutional participation in SLO activities (Kuh, Jankowski, Ikenberry, & Kinzie, 2014). The SBVC SLO experience is consistent with the research findings.

Advisory Committee Minutes. Advisory Committee meeting minutes must be attached in CurricUNET each time a course that is identified as a Career Technical Education (CTE) course is created or updated. College faculty and administrator perceptions of the value of Advisory Committees are directly proportional to their participation in Advisory Committee activities (Kilcrease, 2011). SBVC IT program offers CTE courses, has an advisory committee that meets annually, and the meetings are well attended by the full-time faculty. As with SLOs, Advisory Committee meetings are considered to be an accreditation requirement and their documentation in CurricUNET supports accreditation.

Labor Market Data. The need for CTE courses and programs must be supported with labor market analysis. The use of Labor Market Data is common and may be mandated if the Perkins Modernization Act of 2014, recently introduced in the US House of Representatives, becomes law. At SBVC, the responsibility for researching and producing this data rests with the Department faculty chair. The IT program already uses labor market data and would have little trouble adapting to this requirement if the proposed reform becomes law.

Employment Opportunities

This is related to but distinct from the mandated labor market data analysis. The labor market data projects that there will be sufficient numbers of employment opportunities for students completing the CTE program but the curriculum must provide the students with the necessary knowledge and skills to successfully compete for these jobs. While there is a broad consensus in the academic research literature that IT employers are looking for experience, education, and certifications (Adelman, 2000; Gabberty, 2013; Hunsinger, Smith, & Winter, 2011; Hunsinger & Smith, 2009; Randall & Zirkle, 2005; Robin, 2011; Rodriguez, Fernandez, & Torres, 2011; Wierschem, Zhang, & Johnston, 2010), some significant challenges to the acceptance of IT certifications remain with an equally clear consensus that IT certifications alone are inadequate. The remainder of this section is divided into three subsections covering experience, education, and certifications. The continuing controversy around IT certifications is dealt with in the last subsection.

Experience. Employers view experience as the gold standard. Nothing provides employers with greater confidence that a potential employee can perform adequately in a position than demonstrated performance in a prior work situation (Harris, Greer, Morris, & Clark, 2012; Randall & Zirkle, 2005; Robin, 2011; Rodriguez et al., 2011). Significantly, Rynes et al. (1997) point out that most IT job postings that require college degrees also include experience as a requirement and Robin reports that 80% of IT job postings specify experience. No academic research study was found indicating that employers preferred to higher individuals with no experience. The case for traditional academic degrees is almost as strong.

Education. Generally interpreted as a college degree, education comes in second after experience as an IT employment requirement (Harris et al., 2012; Randall & Zirkle, 2005; Wierschem et al., 2010). There is some dissent regarding the value a degree in particular in comparison to an IT certification. Robin (2011) points out that IT certifications are current and relevant while IT degrees can contain information that is general or dated, while Hopkins, Pickard, and Patrick (2014) find value for employers that IT certifications are validated by industry. Hunsinger and Smith (2009) report employment where IT certifications are used to supplement or even substitute for a college degree. The criticism notwithstanding, there is little doubt that employers value college degrees.

While the acceptance of college degrees is high, the content of degree programs and how effectively they prepare students for employment remains unsettled. The presence of a perception gap is illustrated by the results of the Mourshed, Farrell, and Barton (2012) study showing that while three-fourths of academics believe that their programs prepare students for entry-level employment, less than half of their graduates and those that employ their graduates agree. In addition to the issue of currency and relevance expressed by Robin (2011), academic IT programs need to provide a better balance of technical and soft skills (Harris et al., 2012; Havelka & Merhout, 2010; Litecky, Arnett, & Pra hakar, 2004; Thatcher, Dinger, & George, 2012). While these concerns are for adjustments within the existing education delivery paradigm, there is pressure to reconsider the basis for awarding college credits or at the very least recognize an alternative model.

Outcome-based or competency-based education is becoming a topic of discussion within the academic community. Laitinen (2013) advocates for skills rather than seat time as the measure of college success. This approach requires students to demonstrate the mastery of knowledge or skills rather than devote a number of credit hours to a sequence of courses as the metric for academic success. The proliferation of SLOs, in particular defining these at the program level, moves programs in this direction by providing a method in addition to course grade that can measure student learning. Competency-based education more closely resembles an IT certification than a traditional college degree.

IT Certifications. IT certifications include those that are associated with a particular vendor and those that are not. The vendor neutral certifications, such as those from CompTIA are often considered to include fundamental information such as may be appropriate for entry-level work while vendor specific certifications imply knowledge about specific products (Randall & Zirkle, 2005). Microsoft and Cisco, two of the largest and most successful vendor-specific certification programs (Rajendran, 2011) along with those of many professional organizations such as ISC^2 have stratified certifications ranging from elementary to comprehensive certifications that test insight and skills rather than simple knowledge (Hopkins et al., 2014). While generally accepted by employers, even the most respected IT certifications typically need education or experience to satisfy employer's requirements (Adelman, 2000; Anderson, 2010; Costello, 2009; Hoachlander, Sikora, & Horn, 2001; Hopkins et al., 2014; Hunsinger & Smith, 2009; Quan & Cha, 2010; Randall & Zirkle, 2005; Robin, 2011; Rodriguez et al., 2011; Wierschem et al., 2010).

IT certifications are not, however, a panacea. The value of a certification decreases over time (Cegielski, 2004; Hunsinger & Smith, 2009; Quan & Cha, 2010) and human resources (HR) professionals tend to hold them in higher regard than IT professionals (Randall & Zirkle, 2005). There is no reliable data available to compare one certification with another (Kruchten, 2010; Randall & Zirkle, 2005). It is difficult for a certification candidate to select the appropriate certification to pursue (Whited, 2013). Questions remain about the rigor of IT certifications (Hunsinger & Smith, 2009) and the booming IT certification market is ripe with incentives to hype the value of certifications. This is indeed is an area where the caveat emptor applies.

Transfer

At first glance it might appear that this problem, at least for transfer between a California Community College (CCC) and the California State University, has been solved by the California State legislature. The Student Transfer Reform Act of 2013 mandates that CSU campuses accept CCC transfers with an approved Associates-degree for Transfer. Uncertainty persists however as long as the Information and Communications Technology Associate of Science for Transfer degree (ICT AS-T) remains in draft status. Of particular concern to CSU faculty is the prominence of IT Certificates within the draft ICT AS-T.

The inclusion of IT certifications within college-level work is controversial (Wierschem et al., 2010). IT certifications are challenging to include in academic programs because they, (1) can be blatantly vendor specific, (2) are insufficiently academic, (3) require significant and continuing monetary and instructor training resource investments (Koziniec & Dixon, 2002). This a mixed bag with informed

opinion that these can at the very least, be effectively mitigated contrasted by substantial argument that including IT certifications in academic degrees is fundamentally incompatible with a college education. The issue of bias based upon vendor influence is perhaps the most inflammatory.

Vendor sponsored certifications are clearly identified as such. For example, Microsoft and Cisco both use corporate identity to brand their certifications and related academies. One might expect that college students are sophisticated enough to understand that a certification branded by Microsoft would promote Microsoft products. Furthermore, if an academic course were to use the IT certification as part of, rather than the total course content, it should be simple for instructors to introduce information about other products (Rajendran, 2011). The attractiveness of another alternative, using vendor neutral certifications like CompTIA, is diminished by the observation that they are most often associated with entry-level work and lack the vendor-specific knowledge that many IT jobs require (Hunsinger et al., 2011; Randall & Zirkle, 2005). The compelling nature of employer acceptance of IT certifications data does not address the concern that they are simply inappropriate for academic courses.

The crux of the objections to including IT certifications in a University course is that that they are simply too vocational to be appropriate for the University (Randall & Zirkle, 2005; Schlichting & Mason, 2004). This persists even though the ACM and IEEE both encourage the use of IT certifications (Schlichting & Mason, 2004) and meeting employer needs is an essential function of a business school (Adebayo & Mcgrath, 2013). The inclusion of IT certificate-based courses in CCC courses is, at this point in time, an

impediment to CSU transfer. They have quite the opposite effect for high school transfers.

K12 Articulation

A consequence of the draft ICT AS-T degree is to simplify the articulation process between CCC and K12 programs because it references IT certifications. Unlike Universities, High Schools have embraced entry-level IT certifications. For example, the hugely successful Cisco Networking Academy program that today boasts 10,000 academies in 165 countries enrolling one million students began as a high school program (Cisco, n.d.). Once the draft is approved and CCCs will develop ICT AS-T degrees with courses aligned with IT certifications. High School articulation will then be a simple process of identifying courses at the high school that meet the same IT certification requirements as those at the Community College.

Methodology

The curriculum planning process began with the ICT AS-T draft and the CAE-2Y Knowledge Units (KUs) list with the goal of completely mapping the KUs within a course sequence that could be completely contained within the ICT AS-T draft requirements. The San Bernardino Valley College (SBVC) existing Computer Information Technology (CIT) and Computer Science (CS) courses that most closely matched those in the ICT AS-T draft were identified and these were updated to meet the ICT AS-T requirements. Missing courses that would be required for completion of the ICT AS-T degree and also match KUs were identified and these were created. The total quantity of courses was limited to fit within the maximum allowed under the ICT AS-T

degree. The next stage included involving those outside beyond the SBVC CIT/CS Department faculty.

The concept was presented to the Advisory Committee at the regularly scheduled advisory committee. Publishers of textbooks were contacted and asked to collaborate as were faculty from local high schools. CyberWatch West assisted with KU alignment. All of the input was assembled and the curriculum was updated in CurricUNET. It is currently in the approval queue awaiting the first Curriculum Committee meetings to resume for the Fall 2014 semester. The course SLOs and Labor Market Analysis documents are not visble in CurricuNET without a login. A copy of the SLOs Appendix A, and the Labor Market Analysis, Appendix B, for CIT 110 (equivalent to ITIS 110) as an example of these documents.

Hypotheses

There are three hypotheses. The first hypothesis (H0) relates to CAE/2Y KUs and an ICT AS-T degree. The second hypothesis (H1) considers CAE/2Y KUs and a non-transfer AS degree. The final hypothesis (H2) is for CAE/2Y KUs and a CCC certificate program. For the H0 null hypothesis to be rejected all of the KUs must be identified within TMC draft or approved course descriptions and the units required will not exceed the 60 unit TMC limit. For the H1 null hypothesis to be rejected, (1) a sequence of courses must be identified, (2) there must be support for employability of graduates based on local Labor Market Data, (3) there must be support from the local Advisory Committee, (4) at least 25% of the major courses could be articulated with a K12 program, (5) the total number of units required must allow an adequately prepared student to complete the program within 60 units. Satisfying the first four items of the H1

and substituting two semesters instead of 60 units for the fifth criterion of H1 can reject the H2 hypothesis.

$H0_0$: There is no sequence of courses completely contained within California TMC degree draft or final recommendations that will fulfill all of the CAE/2Y KUs.

$H0_1$: The CAE/2Y KUs will be completely met by the ITIS courses within the California ICT AS-T degree draft recommendations.

$H0_2$: The CAE/2Y KUs will be completely met by a combination of ITIS courses within the California ICT AS-T degree draft recommendations and courses from other pending or approved TMCs that permit completion of the ICT TMC within the 60-unit limit.

$H1_0$: There is no sequence of courses that are aligned with Industry Certifications, supported by labor market data and the Advisory Committee, and provide articulation with K12 programs that will fulfill all of the CAE/2Y KUs and allow a student to complete a non-TMC ICT AS degree within 60 units including all of the other degree course requirements.

$H1_1$: There is a sequence of courses that are aligned with Industry Certifications that will fulfill all of the CAE/2Y KUs and allow a student to complete a non-TMC ICT AS degree within 60 units including all of the other degree course requirements.

$H1_2$: There is a sequence of courses that are supported by labor market data and supported by the Advisory Committee that will fulfill all of the CAE/2Y KUs and

allow a student to complete a non-TMC ICT AS degree within 60 units including all of the other degree course requirements.

$H1_3$: There is a sequence of courses that can be articulated with K12 that will fulfill all of the CAE/2Y KUs and allow a student to complete a non-TMC ICT AS degree within 60 units including all of the other degree course requirements.

$H2_0$: There is no sequence of courses that are aligned with Industry Certifications, supported by labor market data and the Advisory Committee, and provide articulation with K12 programs that will fulfill all of the CAE/2Y KUs and allow a student to complete a CC Certificate within two semesters.

$H2_1$: There is a sequence of courses that are aligned with Industry Certifications that will fulfill all of the CAE/2Y KUs and allow a student to complete a non-TMC ICT AS degree within two semesters

$H2_2$: There is a sequence of courses that are supported by labor market data and supported by the Advisory Committee that will fulfill all of the CAE/2Y KUs and allow a student to complete a non-TMC ICT AS degree within 2 semesters.

$H1_3$: There is a sequence of courses that can be articulated with K12 that will fulfill all of the CAE/2Y KUs and allow a student to complete a non-TMC ICT AS degree within 2 semesters.

Results

Summary of Results

The H0 null hypothesis is not rejected because there is incomplete mapping between KUs and TMC course descriptions. Both the H1 and H2 null hypotheses are

rejected and all alternate hypotheses are accepted. The rest of the results section is divided into 3 subsections with each hypothesis addressed in its own section.

TMC Alignment

There is an incomplete alignment between the National Security Agency/Department of Homeland Security Centers for Academic Excellence in Information Assurance 2-year Education (CAE/2Y) Knowledge Units (KUs) and the course content California draft recommendations for the Information and Communications Technology Transfer Model Curriculum (ICT TMC) Associate of Science Degree (AS). A mapping by ICT TMC course id (C-ID) is in Table 1. The mapping shows that, with the exception of Basic Data Analysis, each of the remaining Core 2Y KUs has at least some required KU topics that align with the ICT TMC AS degree recommendations. The rest of this section is divided into subsections, devoted to each of the CAE-2Y KUs.

Basic Data Analysis. The requirements for this KU are not explicitly covered within any of the ICT TMC courses. This KU identifies the application of critical thinking using the tool of statistical analysis as required knowledge. While this is applicable to IA, it certainly is not specific to this field of study but applies rather broadly to any quantitatively grounded empirical analysis. As such it is found in the SBVC, and presumably many other CCC curricula within an introductory statistics course. There are two options available at SBVC for students to obtain this knowledge, one course in the Mathematics program and the other in the Economics program. The C-ID for Statistics is MATH 110. The mapping for this KU is in Table 2. ITIS 120 is added to this mapping to be sure that the spreadsheet functions are properly covered as a spreadsheet is only one

of several software packages that may be used in the Mathematics Department Statistics course.

Table 1

CAE/2Y Mapping to TMC C-ID

Core 2y Knowledge Units	TMC C-ID(s)
Basic Data Analysis	ITIS 120 + MATH 110
Basic Scripting	COMP 122
Cyber Defense	ITIS 160
Cyber Threats	ITIS 160
Fundamental Security Design Principles	ITIS 160
Information Assurance Fundamentals	ITIS 160
Introduction to Cryptography	ITIS 160
Information Technology Systems Components	ITIS 110
Networking Concepts	ITIS 150
Policy, Legal, Ethics, and Compliance	ITIS 160
Systems Administration	ITIS 155

Table 2

Basic Data Analysis to TMC C-ID

Topic	TMC C-ID(s)
Summary Statistics	MATH 110
Graphing/Charts	ITIS 120 + MATH 110
Spreadsheet Functions	ITIS 120
Problem Solving	ITIS 120 + MATH 110

Scripting. The topics of this KU are easily satisfied with any introductory computer-programming course with the exception of the requirement that a scripting language be taught. At SBVC, there are introductory programming courses based on C++, Java, and VisualBasic.NET but none that explicitly use a scripting language. The mapping for this KU is referenced to the approved AS Computer Science TMC course, C-ID COMP 122, is in Table 3.

Table 3

Scripting to TMC C-ID

Topic	TMC C-ID(s)
Basic Security	COMP 122
Program Commands	COMP 122
Program Control Structures	COMP 122
Variable Declaration	COMP 122
Debugging	COMP 122
Scripting Language	NONE
Basic Boolean logic/operations	COMP 122

Cyber Defense. The topics for this KU are completely aligned with the content of ITIS 160, which is a generic Information Systems Security course. ITIS 160 is aligned with CompTIA Security+ certification, which has network security and risk management as foundational principles. With this emphasis, it is reasonable that ITIS 160 would align well with Cyber Defense KUs. The KU Topic mapping to is enumerated in Table 4.

Table 4

Cyber Defense to TMC C-ID

Topic	TMC C-ID(s)
Network Mapping	ITIS 160
Network Security Techniques and Components	ITIS 160
Applications of Cryptography	ITIS 160
Malicious Activity Detection/Forms of Attack	ITIS 160
Defense in Depth	ITIS 160
Patching	ITIS 110
Vulnerability Scanning	ITIS 160
Vulnerability Windows	ITIS 160

Cyber Threats.

Table 5

Cyber Threats to TMC C-ID

Topic	TMC C-ID(s)
Adversaries and Targets	NONE
Motivations and Techniques	NONE
The Adversary Model	NONE
Types of Attacks	ITIS 160
Attack Timing	NONE
Social Engineering	ITIS 160
Events that Indicate an Attack has Occurred	ITIS 160
Legal Issues	ITIS 160
Attack Surfaces/Vectors	NONE
Insider Problems	ITIS 120
Covert Channels	NONE
Threat Information Sources	NONE

As the mappings in Table 5 illustrate, this KU is not well aligned with any TMC course.

Fundamental Security Design Principles. While there is no TMC course with a security design focus, the topics for these KUs map well to ITIS 160. The mappings are shown in Table 6.

Table 6

Fundamental Security Design Principles to TMC C-ID

Topic	TMC C-ID(s)
Separation	ITIS 160
Isolation	ITIS 160
Encapsulation	ITIS 160
Least Privilege	ITIS 160
Simplicity of Design	NONE
Minimization of Implementation	ITIS 160
Fail Safe Defaults/Fail Secure	ITIS 160
Modularity	ITIS 160

Information Assurance Fundamentals. Slightly more than half of the topics for this KU are well aligned ITIS courses. Five are aligned with ITIS 160 and one with ITIS 150. ITIS 150 is aligned with the CompTIA Security+ certification, which is recommended as a prerequisite for Security+ by CompTIA. Table 7 has the mappings.

Table 7

Information Assurance Fundamentals to TMC C-ID

Topic	TMC C-ID(s)
Threats and Adversaries	NONE
Vulnerabilities and Risks	ITIS 160
Basic Risk Assessment	ITIS 160
Security Life-Cycle	NONE
Intrusion Detection and Prevention Systems	ITIS 160
Cryptography	ITIS 160
Data Security	ITIS 160
Security Models	ITIS 160
Access Control Models	ITIS 150
Confidentiality, Integrity, Availability, etc.	ITIS 160
Security Mechanisms	NONE

Introduction to Cryptography. CompTIA identifies cryptography as an important topic for Security+. As ITIS 160 is aligned with Security+, it makes sense that there is substantial alignment between this course and the topics of this KU. The mapping for the Introduction to Cryptography topics to TMC courses is in table 8.

Table 8

Introduction to Cryptography to TMC C-ID

Topic	TMC C-ID(s)
Symmetric Cryptography	ITIS 160
Public Key Cryptography	ITIS 160
Hash Functions	ITIS 160
Digital Signatures	ITIS 160
Key Management	ITIS 160
Cryptographic Modes	ITIS 160
Types of Attacks	ITIS 160
Common Cryptographic Protocols	ITIS 160

Information Technology Systems Components. The ITIS 110 course is aligned with the A+ certification. This is a computer technician's certification that goes into PC systems and components in great detail. As shown in table 9, it is simple to align the general IT information with ITIS 110 course content with the workstation topics of the Information Technology Systems Components KU. The server information is picked up in the Systems Administration course, ITIS 155 and the final IA-specific options such as IDSEes and security peripherals are found in other ITIS courses.

Table 9

Information Technology System Components to TMC C-ID

Topic	TMC C-ID(s)
Workstations	ITIS 110
Servers	ITIS 155
Network Storage Devices	ITIS 155
Routers/Switches/Gateways	ITIS 150
Guards/CDSes/VPNs/Firewalls	ITIS 150
IDSes, IPSes	ITIS 160
Peripheral Devices/Security Peripherals	ITIS 110 & ITIS 160

Networking Concepts. The topics for this KU are completely contained in ITIS 150 and the mapping is enumerated in Table 10.

Table 10

Networking Concepts to TMC C-ID

Topic	TMC C-ID(s)
Networking Overview (OSI model)	ITIS 150
Network Media	ITIS 150
Network Architectures (LANs, WANs)	ITIS 150
Network Devices (Routers, Switches, etc.)	ITIS 150
Network Services	ITIS 150
Network Protocols	ITIS 150
Network Topologies	ITIS 150
Overview of Network Security Issues	ITIS 150 & ITIS 160

Policy, Legal, Ethics and Compliance. The topics for this KU are mostly aligned with the content of the ITIS 160 course. The mapping is enumerated in Table 11.

Table 11

Policy, Legal, Ethics and Compliance to TMC C-ID

Topic	TMC C-ID(s)
HIPAA/FERPA	ITIS 160
Computer Security Act	ITIS 160
Sarbanes-Oxley	NONE
Gram-Leach-Billey	ITIS 160
Privacy (COPPA)	ITIS 150
PCI DSS	NONE
Sate US and International Sandards/Jurisdictions	ITIS 160
Laws and Authorities	ITIS 160
US Patriot Act	ITIS 160
BYOD	ITIS 160
Americans with Disabilities Act, Section 508	NONE

Systems Administration. The topics for this KU are well aligned with the content of ITIS 155 and the mapping is enumerated in Table 12.

Table 12

Systems Administration to TMC C-ID

Topic	TMC C-ID(s)
OS Installation	ITIS 155
User Account Management	ITIS 155
Authentication Methods	ITIS 110
Command Line Interfaces	ITIS 110
Configuration Management	ITIS 155
Updates and Patches	ITIS 155
Access Controls	ITIS 155
Logging and Auditing	ITIS 155
Managing System Services	ITIS 155
Virtualization	ITIS 155
Backup and Restoring Data	ITIS 155
File System Security	ITIS 155
Network Configuration	ITIS 155
Host –based Intrusion Detection	ITIS 160
Security Policy Development	ITIS 160

Analysis and Conclusions

There are 110 KU topics in the table and 15 are not within TMC courses. Given that the mapping between the TMC and the CAE/2Y KUs is incomplete, adjustments must be made. Two approaches are evident, (1) add material to existing TMC courses and (2) add one or more new courses. There are advantages and disadvantages to approaches. In addition a third or hybrid approach that both adds some material to existing courses and create a new course for other material is also a possibility. The non-

transfer AS and Certificate can use the TMC courses, once they are adjusted to encompass all of the KUs.

CAE/2Y and the TMC

Adding to Existing Courses. Adding material to existing courses would necessarily mean changing the planned course structure. For courses that include a lab component, one approach would be to eliminate the lab work. This would provide more lecture time to cover the added material. A second approach would be to retain the lab and increase the number of units for the course. Adding lecture time, which equates to more units, is the only way to accomplish this for courses with no lab.

Eliminating lab work to squeeze in more lectures is incompatible with both the CAE/2Y KUs and the TMC course requirements. Some KUs explicitly require hands-on activities. For example, two of the outcomes identified in the networking KU require that students use network tools. It would be difficult to justify an assessment of usage outcomes without providing students with an opportunity to use the tools. Furthermore, the methods of evaluation section of the TMC course description generally include hands-on projects as a required assessment method.

Adding time and therefore units to a TMC course is difficult because there is a 60-semester unit cap on courses required for a TMC and this includes required general education work. Increasing the units for required major courses when there is little unit flexibility must be done with care. This type of change is certainly something that would need to be justified to the Curriculum Committee and the College Articulation Officer.

New Courses. Requiring a new TMC course is even less attractive than adding material to an existing TMC course. While adding material to a TMC course might be

something that could be justified to a Curriculum Committee, adding courses to the TMC would require concurrence of the Academic Senates of CSU and CCC. Not an endeavor for the faint of heart and certainly nothing that could be completed in a reasonable amount of time. The third, or hybrid option, inherits all of the disadvantages of the other two options and provides no solutions to either problem.

Conclusion. The inevitable conclusion is that the TMC is simply too restrictive to accommodate adding a course to match the CAE/2Y KUs. The alternative approach, adding material to the courses will work. The TMC unit designations are minimums not maximums and adding to the courses is the approach that is used here.

Adjusting TMC Courses

Changing fewer courses is better than changing many. Adjusting just two courses ITIS 155 and ITIS 160 can cover all 14 missing KUs. This will be accomplished by adding one unit to each. The KUs will then be added to the courses as listed in Table 13.

Table 13

KUs added to ITIS 155 and ITIS 160

ITIS 155	ITIS 160
Basic Scripting (1 KU)	Cyber Threats (7 KUs)
	Fundamental Security Design (1 KU)
	IA Fundamentals (3 KUs)
	Policy (3 KUs)

CAE/2Y and the non-TMC Associates Degree and Certificate

The non-TMC associates degree, these are called Associate of Applied Science or Associates of Applied Arts at many institutions, and certificate come provide more flexibility at the College level. As they are not intended for transfer, articulation with

CSU is of no concern and the College has the flexibility to use courses that align with Vendor-specific IT certifications, such as Cisco. This would be a benefit for the non-transfer programs because many local high schools use the Cisco curriculum. This makes the articulation easier and allows high school students to transfer and complete a program more efficiently.

Course Sequences

The transfer course sequence is listed in table 14 and the non-transfer course sequence alternates to facilitate K12 transfer are listed in table 15. The same non-transfer courses can be used for both the AS degree and the Certificate. All C-ID course descriptors are in Appendix C.

Table 14

Transfer Major Courses

ITIS Course ID	Course Name
MATH 110	Introduction to Statistics
COMP 122	Programming Concepts and Methodology I
ITIS 110	Information & Communications Technology Essentials
ITIS 120	Business Information Systems, Computer Information Systems
ITIS 150	Computer Network Fundamentals
ITIS 155	Systems and Network Administration
ITIS 160	Introduction to Information Systems Security

Table 15

Non-Transfer Major Courses

ITIS Course ID	Alternate
MATH 110	No Alternate, this course is required
COMP 122	Any Introductory programming course
ITIS 110	Any A+ course
ITIS 120	No Alternate, this course is required
ITIS 150	Cisco Academy first 2 courses or CCENT Certification
ITIS 155	No Alternate, this course is required
ITIS 160	Cisco CCNA Security or CCNA Security Course

Experience is Most Valued by Employers

Employers place a higher value on work experience than either degrees or Industry Certifications. This is clear from the research literature and what is also clear is that curriculum developers fail to emphasize experience and technical skills showing much less appreciation for them than do employers (Harris et al., 2012). Information Technology curriculum benefits from hands-on activities but would be better still with real work experience. Ideally the curriculum should recognize the value that students receive from working in IT-related jobs but at the very least it shouldn't get in the way of that option.

Work is a necessity for many SBVC students. The good news is that not only do working students achieve academically at levels that is similar to their non-working peers, they also fair better in the job market after graduation (Gleason, 1993). One approach could be to help students who are working anyway to find low-level jobs in the IT field. Having a curriculum that provides a student with entry-level Industry

certifications early is one way to help them qualify for entry-level IT jobs while they complete their studies.

Future Research

The research shows that employers consider three factors when hiring IT workers, (1) experience, (2) education, (3) certifications. This curriculum does a good job of providing the education, a marginally adequate job in terms of certifications and is completely silent when it comes to experience. Future research investigating how CCCs can help students obtain certifications and get that all important first IT job is needed.

Many of the TCM IT IS courses reference IT Industry Certifications. Mapping the Certification to the KUs could complete a more thorough mapping.

References

Adebayo, A. O., & Mcgrath, L. C. (2013). Technology skill for business students: The next level. *Business Education Innovation Journal*, *5*(2), 6–11.

Adelman, C. (2000). A parallel universe: Certification in the information technology guild. *Change*, 20–29.

Anderson, D. (2010). Education program administration implications of information technology certification trends. *International Journal of Leadership in Educational Technology*, *1*(6), 1–17.

Cegielski, C. G. (2004). Who values technology certification? *Communications of the ACM*, *47*(10), 103. doi:10.1145/1022594.1022627

Cisco. (n.d.). *About networking Academy - networking academy*. Retrieved from https://www.netacad.com/web/about-us/about-networking-academy;jsessionid=87300F4D65403731CCEF3208870511DD.node1

Cooper, W. J. (1928). The junior-college movement in California. *The School Review*, *36*(6), 409–422.

Costello, T. (2009). Certification : Does the emperor have any clothes? *IT Professional Magazine*, (October), 63–65.

Gabberty, J. W. (2013). Educating the next generation of computer security professionals: The rise and relevancy of professional certifications. *Review of Business Information Systems*, *17*(3), 85–99.

Gleason, P. M. (1993). College student employment, academic progress, and psotcollege labor market success. *Journal of Student Financial Aid*, *23*(2), 5–14.

Harris, A., Greer, T., Morris, S., & Clark, W. (2012). Information systems job market late 1970's-early 2010's. *Journal of Computer Information Systems*, *53*(1), 72–79. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Information+Systems+job+market+late+1970's-early+2010's#0

Havelka, D., & Merhout, J. (2010). Toward a theory of information technology professional competence. *Journal of Computer Information Systems*, *50*(2), 106–116.

Hoachlander, G., Sikora, A. C., & Horn, L. (2001). Community college students: Goals, academic preparation, and outcomes. *Community College Review*, *29*(3), 121–170.

Hopkins, C. W., Pickard, J., & Patrick, A. (2014). Getting students certified: A study of certification pass rates in information technology degree programs. In *American Society for Engineering Education Gulf-Western Conference* (pp. 1–13). New Orleans, LA.

Hunsinger, D. S., & Smith, M. (2009). IT certification use by hiring personnel. *The Journal of Computer Information Systems*, *50*(2), 71–82.

Hunsinger, D. S., Smith, M. A., & Winter, S. J. (2011). A framework of the use of certifications by hiring personnel in IT hiring decisions. *Data Base for Advances in Information Systems*, *42*(1), 9–28.

Kilcrease, K. M. (2011). Faculty perceptions of business advisory boards : The challenge for effective communication. *Journal of Education for Business*, *86*(2), 78–83. doi:10.1080/08832323.2010.480989

Koziniec, T. W., & Dixon, M. W. (2002). ICT industry certification: Integration issues for post-secondary educational institutions in Australia. In *Informing Science and IT Education* (pp. 831–838).

Kruchten, P. (2010). Career development: Certification 1, 2, 3. *IEEE Software*, *27*(3), 92–94.

Kuh, G. D., Jankowski, N., Ikenberry, S. O., & Kinzie, J. (2014). *Knowing what students know and can do: The current state of student learning outcomes assessment in U.S. colleges and universities*.

Laitinen, A. M. Y. (2013). Changing the way we account for college credit. *Issues in Science and Technology*, *29*(2), 62–69.

Litecky, C. R., Arnett, K. P., & Pra hakar, B. (2004). The paradox of soft skills versus technical skills in IS hiring. *Journal of Computer Information Systems*, *45*(1), 69–76.

Mourshed, M., Farrell, D., & Barton, D. (2012). *Education to employment : Designing a system that works* (pp. 1–6).

Quan, J., & Cha, H. (2010). IT certifications, outsourcing and information systems personnel turnover. *Information Technology & People*, *23*(4), 330–351. doi:10.1108/09593841011087798

Rajendran, D. (2011). Does embedding an ICT certification help align tertiary programs with industry? A study of CCNA perceptions. *Journal of Applied Computing and Information Technology*, *15*(01).

Randall, M. H., & Zirkle, C. J. (2005). Information technology student-based certification in formal education settings: Who benefits and what is needed. *Journal of Information Technology Education*, *4*, 287–306.

Robin, G. J. (2011). Do companies look for education , certifications or experience : A quantitative analysis current industry needs/requirements. In *SIGMIS-CPR* (pp. 1–5). San Antonio, Texas, USA: ACM.

Rodriguez, O., Fernandez, F., & Torres, R. (2011). Impact of information technology certifications in Puerto Rico. *Management Research: The Journal of the Iberoamerican Academy of Management*, *9*(2), 137–153. doi:10.1108/1536-541111155254

Rynes, S. L., Orlitzky, M. O., & Bretz, R. D. (1997). Experienced Hiring Versus College Recruiting: Practices and Emerging Trends. *Personnel Psychology*, *50*(2), 309–339. doi:10.1111/j.1744-6570.1997.tb00910.x

Schlichting, C., & Mason, J. (2004). Certification training and the academy. *Journal of Computer Science in Colleges*, *20*(1), 157–167.

Thatcher, J., Dinger, M., & George, J. F. (2012). Information Technology worker recruitment : An empirical examination of entry-level IT job eeekers' labor market. *Communications of the Association for Information Systems*, *31*(1), 1–34.

Whited, J. (2013). Selecting from the alphabet soup of information certifications. *Information Management*, *47*(2), 22–26.

Wierschem, D., Zhang, G., & Johnston, C. R. (2010). Information technology certification value : An initial response from employers. *Journal of International Technology and Information Management*, *19*(4), 89–106.

Appendix A

COMPUTER INFORMATION TECHNOLOGY DEPARTMENT

CIT 110 - STUDENT LEARNING OUTCOMES

Carry out trouble-shooting strategies for resolving an identified end-user IT problem.

- Below Expectations: Lists appropriate methods or techniques to identify and resolve end-user IT problems
- Meets Expectations: Investigates a given problem using appropriate methods or techniques, including communication and technical strategies.
- Exceeds Expectations: Analyzes and end-user IT problem to successful resolution.

Identify basic components of an end-user IT system and describe their functions.

- Below Expectations: Lists some but not all components of an end-user IT system or incorrectly lists those components or cannot identify the functions.
- Meets Expectations: Describes the basic components of an end-user IT system and their functions.
- Exceeds: Diagrams the basic components of an end-user IT system and how they function together to create a complete system.

Implement an end-user system hardware and software configuration responsive to an identified scenario.

- Below Expectations: Identifies hardware and software components.
- Meets Expectations: Implements an appropriate hardware and software configuration for a particular situation.
- Exceeds Expectations: Compares and contrasts several options and justifies the recommended solution.

Differentiate among various operating systems.

- Below Expectations: Describes a few commonly used operating systems.
- Meets Expectations: Summarizes several operating systems and differentiates among them.
- Exceeds Expectations: Compares several operating systems in terms of computing platform and usability.

Apply basic security to end-user IT systems.

- Below Expectations: Requires assistance to apply basic end-user IT system security.
- Meets Expectations: Applies basic end-user IT System security.
- Exceeds Expectations: Applies and documents basic end-user IT system security.

Appendix B

COMPUTER INFORMATION TECHNOLOGY DEPARTMENT

CIT 110 LABOR MARKET REPORT

The following analysis is based on data retrieved from the September 2012 update of the 2010-2020 Occupational Employment Projections for the Riverside-San Bernardino-Ontario Metropolitan Statistical area published by the State of California Employment Development Department (Cal-EDD) retrieved from http://www.calmis.ca.gov. Relevant rows extracted from the full Cal-EDD spreadsheet is in the attached pdf formatted file CIT110LaborMarketReportData.

SOC code 49-2011as defined by the US Department of Labor is the employment field most directly related to the material covered in CIT 110. CIT 110 prepares students to seek entry-level employment as a Computer, Automated Teller, and Office Machine Repairer. The projected job growth between 2010 and 2020 in this field is 8.3% with a projection of 36 total jobs available each year. The median annual salary for workers in this field is $38,519 per year. It is common for employers to seek new employees who are high school graduates.

This course is part of the Computer Support Specialist Certificate. This certificate is designed to align with SOC code 15-1150, Computer Support Specialists. Students who continue beyond CIT 110 to complete the Computer Support Specialist Certificate will find an occupation with 19.5% job growth between 2010 and 2020. There are projected to be 157 job openings annually for Computer Support Specialists. The median salary for Computer Support Specialist is $47,924 per year. Some college courses without a degree is expected of entry-level workers.

Appendix C

MATH 110 DESCRIPTOR

Discipline: Mathematics	Sub-discipline:
General Course Title: Introduction to Statistics	Min. Units 3
General Course Description: The use of probability techniques, hypothesis testing, and predictive techniques to facilitate decision-making. Topics include descriptive statistics; probability and sampling distributions; statistical inference; correlation and linear regression; analysis of variance, chi-square and t-tests; and application of technology for statistical analysis including the interpretation of the relevance of the statistical findings. Applications using data from disciplines including business, social sciences, psychology, life science, health science, and education.	
Number: 110	Suffix:
Any rationale or comment Typically satisfies general education quantitative reasoning requirement (CSU GE B4).	
Required Prerequisites: Intermediate Algebra	
Advisories/Recommended Preparation[1]	
Course Content: 1. Summarizing data graphically and numerically; 2. Descriptive statistics: measures of central tendency, variation, relative position, and levels/scales of measurement; 3. Sample spaces and probability; 4. Random variables and expected value; 5. Sampling and sampling distributions; 6. Discrete distributions – Binomial; 7. Continuous distributions – Normal; 8. The Central Limit Theorem; 9. Estimation and confidence intervals; 10. Hypothesis Testing and inference, including t-tests for one and two populations, and Chi-square test; 11. Correlation and linear regression and analysis of variance (ANOVA); 12. Applications using data from disciplines including business, social sciences, psychology, life science, health science, and education; and 13. Statistical analysis using technology such as SPSS, EXCEL, Minitab, or graphing calculators. Laboratory Activities: (if applicable)	
Course Objectives: *Upon successful completion of the course, students will be able to:* 1. Distinguish among different scales of measurement and their implications; 2. Interpret data displayed in tables and graphically;	

[1] Advisories or recommended preparation will not require validation but are recommendations to be considered by the student prior to enrolling.

3. Apply concepts of sample space and probability;
4. Calculate measures of central tendency and variation for a given data set;
5. Identify the standard methods of obtaining data and identify advantages and disadvantages of each;
6. Calculate the mean and variance of a discrete distribution;
7. Calculate probabilities using normal and student's t-distributions;
8. Distinguish the difference between sample and population distributions and analyze the role played by the Central Limit Theorem;
9. Construct and interpret confidence intervals;
10. Determine and interpret levels of statistical significance including p-values;
11. Interpret the output of a technology-based statistical analysis;
12. Identify the basic concept of hypothesis testing including Type I and II errors;
13. Formulate hypothesis tests involving samples from one and two populations;
14. Select the appropriate technique for testing a hypothesis and interpret the result;
15. Use linear regression and ANOVA analysis for estimation and inference, and interpret the associated statistics; and
16. Use appropriate statistical techniques to analyze and interpret applications based on data from disciplines including business, social sciences, psychology, life science, health science, and education.

Methods of Evaluation:
Tests, examinations, homework or projects where students demonstrate their mastery of the learning objectives and their ability to devise, organize and present complete solutions to problems.

Sample Textbooks, Manuals, or Other Support Materials
A college level text supporting the learning objectives of this course.

FDRG Lead Signature: Date: 12-15-12

[For Office Use Only]	**Internal Tracking Number**

COMP 122 DESCRIPTOR

Discipline: Computer Science	Sub-discipline:	
General Course Title: **Programming Concepts and Methodology I**		Min. Units 3
General Course Description: Introduces the discipline of computer science using a high level language utilizing programming and practical hands-on problem solving.		
Number: COMP 122	Suffix:	
First course in a sequence of courses that is compliant with the standards of the Association for Computing Machinery (ACM).		
Required Prerequisites or Co-Requisites[2] Prerequisite: None		
Advisories/Recommended Preparation[3] COMP 112 (CS0) or Comparable Experience		

Course Content:

I. Programming Fundamentals (PF)
PF1. Fundamental programming constructs
Minimum coverage time: 9 hours

Topics
1. Basic syntax and semantics of a higher-level language
2. Variables, types, expressions, and assignment
3. Simple I/O
4. Conditional and iterative control structures
5. Functions and parameter passing
6. Structured decomposition

Learning Outcomes
1. Analyze and explain the behavior of simple programs involving the fundamental programming constructs covered by this unit;
2. Modify and expand short programs that use standard conditional and iterative control structures and functions;
3. Design, implement, test, and debug a program that uses each of the following fundamental programming constructs: basic computation, simple I/O, standard conditional and iterative structures, and the definition of functions;
4. Choose appropriate conditional and iteration constructs for a given programming task;
5. Apply the techniques of structured (functional) decomposition to break a

[2] Prerequisite or co-requisite course need to be validated at the CCC level in accordance with Title 5 regulations; co-requisites for CCCs are the linked courses that must be taken at the same time as the primary or target course.
[3] Advisories or recommended preparation will not require validation but are recommendations to be considered by the student prior to enrolling.

program into smaller pieces; and
6. Describe the mechanics of parameter passing.

PF2. Algorithms and problem-solving
Minimum coverage time: 6 hours

Topics
1. Problem-solving strategies
2. The role of algorithms in the problem-solving process
3. Implementation strategies for algorithms
4. Debugging strategies
5. The concept and properties of algorithms

Learning outcomes
1. Discuss the importance of algorithms in the problem-solving process;
2. Identify the necessary properties of good algorithms;
3. Create algorithms for solving simple problems;
4. Use pseudocode or a programming language to implement, test, and debug algorithms for solving simple problems; and
5. Describe strategies that are useful in debugging.

II. Programming Languages (PL)
PL1. Overview of programming languages
Minimum coverage time: 2 hours

Topics
1. History of programming languages
2. Brief survey of programming paradigms
3. Procedural languages
4. Object-oriented languages

Learning outcomes
1. Summarize the evolution of programming languages illustrating how this history has led to the paradigms available today; and
2. Identify at least one distinguishing characteristic for each of the programming paradigms covered in this unit.

PL4. Declarations and types
Minimum coverage time: 3 hours

Topics
1. The conception of types as a set of values together with a set of operations

Declaration models (binding, visibility, scope, and lifetime)
2. Overview of type-checking

Learning outcomes
1. Explain the value of declaration models, especially with respect to programming-in-the-large;
2. Identify and describe the properties of a variable such as its associated address, value, scope, persistence, and size;
3. Discuss type incompatibility;
4. Demonstrate different forms of binding, visibility, scoping, and lifetime management; and
5. Defend the importance of types and type-checking in providing abstraction and safety.

Topics fulfilling these tasks and outcomes could include OOPS and other programming elements. This course is recommended to contain hands-on programming and problem solving tasks.

Course Objectives: *At the conclusion of this course, the student should be able to:*

1. Design, implement, test, and debug a program that uses each of the following fundamental programming constructs: basic computation, simple I/O, standard conditional and iterative structures, and the definition of functions;

2. Use pseudocode or a programming language to implement, test, and debug algorithms for solving simple problems

3. Summarize the evolution of programming languages illustrating how this history has led to the paradigms available today

4. Demonstrate different forms of binding, visibility, scoping, and lifetime management

Methods of Evaluation: May include any or all of
Exams
Quizzes
Programming Projects
Discussions
Class Presentations

Sample Textbooks, Manuals, or Other Support Materials Savitch, Walter: Problem Solving with C++ Latest Edition	
FDRG Lead Signature:	Date: 5/12/12
[For Office Use Only]	**Internal Tracking Number**

ITIS 110 DESCRIPTOR

Discipline: Information Technology/ Information Systems	Proposed Sub-discipline (if applicable):
General Course Title: **Information & Communication Technology Essentials**	Min. Units 4
General Course Description: This course provides an introduction to the computer hardware and software skills needed to help meet the growing demand for entry-level ICT professionals. The fundamentals of computer hardware and software as well as advanced concepts such as security, networking, and the responsibilities of an ICT professional will be introduced. Preparation for CompTIA's A+ certification exam.	
Proposed Number: ITIS 110	Proposed Suffix:
Required Prerequisites or Co-Requisites[4]: None.	
Advisories/Recommended Preparation[5]: This course should prepare students for the current version(s) of CompTIA's A+ certification exam(s).	
Course Content: 1. PC hardware 2. Networking 3. Laptops 4. Printers 5. Operational procedures 6. Operating systems 7. Security 8. Mobile devices 9. Troubleshooting	
Course Objectives: *At the conclusion of this course, the student should be able to:* 1. assemble components based on customer requirements. 2. install, configure and maintain devices, PCs and software for end users. 3. understand the basics of networking and security/forensics. 4. properly and safely diagnose, resolve and document common hardware and software issues while applying troubleshooting skills. 5. provide appropriate customer support.	

[4] Prerequisite or co-requisite course need to be validated at the CCC level in accordance with Title 5 regulations; co-requisites for CCCs are the linked courses that must be taken at the same time as the primary or target course.

[5] Advisories or recommended preparation will not require validation but are recommendations to be considered by the student prior to enrolling.

6. understand the basics of virtualization, desktop imaging, and deployment.
Methods of Evaluation: Evaluation will include hands-on projects and a combination of examinations, presentations, discussions, or problem-solving assignments.
Sample Textbooks, Manuals, or Other Support Materials (do not include editions or publication dates): • Meyers, M. - Mike Meyers' CompTIA A+ Guide to 801 Managing and Troubleshooting PCs (Exam 220-801 or later) **AND** Mike Meyers' CompTIA A+ Guide to 802 Managing and Troubleshooting PCs (Exam 220-802 or later) (Also consider using the accompanying Lab Manual.) • Andrews, J. - A+ Guide to Managing & Maintaining Your PC (Also consider using the accompanying Lab Manual.) • Cisco Networking Academy - IT Essentials: PC Hardware and Software Companion Guide
FDRG Lead Signature: Date: 19Dec2013
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ITIS 120 DESCRIPTOR

Discipline: ITIS	Sub-discipline:BUS
General Course Title: Business Information Systems, Computer Information Systems	Min. Units 3
General Course Description: Examination of information systems and their role in business. Focus on information systems, database management systems, networking, e-commerce, ethics and security, computer systems hardware and software components. Application of these concepts and methods through hands-on projects developing computer-based solutions to business problems.	
Number: ITIS120, BUS140	Suffix:
Any rationale or comment	
Required Prerequisites or Co-Requisites[6]	
Advisories/Recommended Preparation[7]	
Course Content: 1. Information systems concepts 2. Communication and network concepts, systems, and applications 3. Internet usage; e-business systems 4. System infrastructure concepts 5. System and Application software programs and concepts 6. Information systems security, crime, and ethics 7. Types of information systems and their roles in business 8. Systems development life cycle 9. Organization and management of structured and unstructured data using spreadsheets and database tools 10. Practical exercises in electronic spreadsheet development 11. Practical exercises in using database software 12. Practical exercises in Internet technologies	
Course Objectives: *At the conclusion of this course, the student should be able to:*	

[6] Prerequisite or co-requisite course need to be validated at the CCC level in accordance with Title 5 regulations; co-requisites for CCCs are the linked courses that must be taken at the same time as the primary or target course.

[7] Advisories or recommended preparation will not require validation but are recommendations to be considered by the student prior to enrolling.

1. Describe existing and emerging technologies and their impact on organizations and society. 2. Demonstrate an understanding of the development and use of information systems in business. 3. Solve common business problems using appropriate Information Technology applications and systems.
Methods of Evaluation: Evaluation will include hands-on projects and a combination of examinations, presentations, discussions, or problem-solving assignments.
Sample Textbooks, Manuals, or Other Support Materials: New Perspectives on Computer Concepts – Current Edition: Boston, Mass. Cengage Learning. Introduction to Information Systems, Supporting and Transforming Business, current edition, Wiley. Discovering Computers Complete -Current Edition: Boston, MASS. Cengage Learning
FDRG Lead Signature: Date:
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ITIS 150 DESCRIPTOR

Discipline: Information Technology/ Information Systems	Proposed Sub-discipline (if applicable):
General Course Title: **Computer Network Fundamentals**	Min. Units 3
General Course Description: This course introduces the architecture, structure, functions, components, and models of the Internet and other computer networks. The principles and structure of IP (Internet Protocol) addressing and the fundamentals of Ethernet concepts, media, and operations are introduced to provide a foundation for further study of computer networks. It uses the OSI (Open Systems Interconnection) and TCP (Transmission Control Protocol) layered models to examine the nature and roles of protocols and services at the application, network, data link, and physical layers.	
Proposed Number: ITIS 150	Proposed Suffix:
Required Prerequisites or Co-Requisites[8]: None.	
Advisories/Recommended Preparation[9]: This course should prepare students for the current version of CompTIA's Network+ certification exam.	
Course Content: 10. OSI (Open Systems Interconnection) and TCP/IP (Transmission Control Protocol/Internet Protocol) layered models 11. IP addressing (IPv4 and IPv6) 12. Routing and switching 13. Functions of common networking protocols 14. DNS (Domain Name System) 15. Network troubleshooting methodology 16. Installation and configuration of routers and switches for a given scenario 17. Installation and configuration of a wireless network for a given scenario 18. DHCP (Dynamic Host Configuration Protocol) 19. Planning and implementation of a basic SOHO (Small Office/Home Office) network for a given set of requirements. 20. Standard media types (for example: Fiber, Copper), associated properties, standard connector types	

[8] Prerequisite or co-requisite course need to be validated at the CCC level in accordance with Title 5 regulations; co-requisites for CCCs are the linked courses that must be taken at the same time as the primary or target course.

[9] Advisories or recommended preparation will not require validation but are recommendations to be considered by the student prior to enrolling.

21. Wireless standards
22. WAN (Wide Area Networks) technology types and properties
23. Network topologies (for example: Ring, Star, Client-server)
24. LAN (Local Area Networks) technology types and properties
25. Hardware and software tools to troubleshoot connectivity issues
26. Network monitoring resources to analyze traffic
27. Network performance optimization
28. Wireless Security Measures
29. Network Access Security Methods
30. User authentication Methods
31. Common threats, vulnerabilities, and mitigation techniques
32. Installation and configuration of a basic firewall
33. Network Security appliances and methods

Course Objectives: *At the conclusion of this course, the student should be able to:*

7. describe and differentiate the devices and services used to support communications in data networks and the Internet.
8. describe the role of protocol layers in data networks.
9. evaluate the importance of addressing and naming schemes at various layers of data networks in IPv4 and IPv6 environments.
10. design, calculate, and apply subnet masks and addresses to fulfill given requirements in IPv4 and IPv6 networks.
11. explain fundamental Ethernet concepts such as media, services, and operations.
12. build a simple Ethernet network using routers and switches.
13. compose Cisco command-line interface (CLI) commands to perform basic router and switch configurations.
14. experiment with common network utilities to verify small network operations and analyze data traffic.

Methods of Evaluation:

Evaluation will include hands-on projects and a combination of examinations, presentations, discussions, or problem-solving assignments.

Sample Textbooks, Manuals, or Other Support Materials (do not include editions or publication dates):

- Dean, T. - Network+ Guide to Networks
- Tomsho, G. - Guide to Networking Essentials
- Cisco Academy Program - Network Fundamentals CCNA Academy Companion Guide

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ITIS 155 DESCRIPTOR

Discipline: Information Technology/ Information Systems	Proposed Sub-discipline:
General Course Title: **Systems and Network Administration**	Min. Units 3
General Course Description: This course will provide a student with the knowledge and skills required to build, maintain, troubleshoot and support server hardware and software technologies. The student will be able to identify environmental issues; understand and comply with disaster recovery and physical / software security procedures; become familiar with industry terminology and concepts; understand server roles / specializations and interaction within the overall computing environment.	
Proposed Number: ITIS 155	Proposed Suffix:
Required Prerequisites or Co-Requisites[10]: None.	
Advisories[11]: Business Information Systems/Computer Information Systems (ITIS 120 or BUS 140) This course should prepare students for the current version of CompTIA's Server+ certification exam.	
Course Content: 1. Introduction to servers a. Examine the network architecture b. Identify common server types and functions 2. Exploring the server hardware a. Identify server system board components b. Explore system processing core c. Explore server memory d. Examine server cooling and power systems 3. Introduction to server software a. Describe server software b. Network operating system (NOS) management features c. Network operating system (NOS) security features d. Network essentials for servers 4. Exploring the server storage system	

[10] Prerequisite or co-requisite course need to be validated at the CCC level in accordance with Title 5 regulations; co-requisites for CCCs are the linked courses that must be taken at the same time as the primary or target course.

[11] Advisories or recommended preparation will not require validation but are recommendations to be considered by the student prior to enrolling.

a. Examine storage devices used for servers
b. Exploring disk interfaces, such as Integrated Drive Electronics (IDE) and Small Computer System Interface (SCSI)
c. Describe Random Arrays of Independent Disks (RAID)
d. Explore Network-Attached Storage (NAS) implementations
e. Explore Storage Area Network (SAN) implementations

5. Installing the server hardware
    a. Identify the best practices in server hardware installation
    b. Install hardware components on a server
    c. Verify server installation
    d. Install a server in a network environment
6. Configuring servers
    a. Network operating system (NOS) installation and verification
    b. Install system monitoring agents and service tools
    c. Server configuration documentation
7. Examining the issues in upgrading server components
    a. Examine an upgrade checklist
    b. Examine the issues in upgrading server hardware
    c. Examine the issues in upgrading server software
8. Examining servers in an it environment
    a. Industry best practices for server installation and maintenance
    b. Server security and access methods
9. Troubleshooting servers
    a. Examine the troubleshooting theory and methodologies
    b. Troubleshoot server hardware problems
    c. Troubleshoot server software problems
    d. Troubleshoot server network problems
    e. Troubleshoot server storage device problems
10. Exploring disaster recovery concepts and methodologies
    a. Examine disaster recovery plans
    b. Implement disaster recovery methodologies
    c. Implement replication methods

Course Objectives: *At the conclusion of this course, the student should be able to:*

1. examine server fundamentals.
2. identify the hardware components of a server.
3. describe the features of server software.
4. examine the various types of storage systems used in servers.
5. install hardware components on a server.
6. configure servers.
7. examine the issues in upgrading server components.
8. identify some of the industry's best practices for deploying a server and the various strategies of securing, accessing, and remotely managing the server hardware.
9. troubleshoot servers.

10. describe disaster recovery concepts and techniques.
Methods of Evaluation: Evaluation will include hands-on projects and a combination of examinations, presentations, discussions, or problem-solving assignments.
Sample Textbooks, Manuals, or Other Support Materials (do not include editions or publication dates): • CompTIA Server+ Certification (ILT), CompTIA • Microsoft Corporation - Exam 70-411 Administering Windows Server 2012 (Microsoft Official Academic Course Series) • Eckert, J. & Schitka, M. J. - Linux+ Guide to Linux Certification, including the Lab Manual by Sawicki, E. • Limoncelli, T., Hogan C. & Chalup, S. - The Practice of System and Network Administration
FDRG Lead Signature: Date: 19Dec2013
[For Office Use Only] **Internal Tracking Number**

ITIS 160 DESCRIPTOR

Discipline: Information Technology/ Information Systems	Proposed Sub-discipline (if applicable):
General Course Title: **Introduction to Information Systems Security**	Min. Units 3
General Course Description: An introduction to the fundamental principles and topics of Information Technology Security and Risk Management at the organizational level. It addresses hardware, software, processes, communications, applications, and policies and procedures with respect to organizational Cybersecurity and Risk Management.	
Proposed Number: ITIS 160	Proposed Suffix:
Required Prerequisites[12]: Business Information Systems/Computer Information Systems (ITIS 120 or BUS 140)	
Advisories/Recommended Preparation[13]: The use of case examples for discussion and reflection in this course is highly recommended.	
Course Content: 1. Security Overview 2. Authentication 3. Attacks and Malicious Code 4. Remote Access 5. E-Mail Security 6. Web Security 7. Directory and File Transfer Services 8. Hardware Devices 9. Network Media and Medium 10. Network Security Topologies 11. Intrusion Detection 12. Security Baselines 13. Cryptography 14. Physical Security 15. Disaster Recovery and Business Continuity 16. Computer Forensics and Advanced Topics	

[12] Prerequisite or co-requisite course need to be validated at the CCC level in accordance with Title 5 regulations; co-requisites for CCCs are the linked courses that must be taken at the same time as the primary or target course.

[13] Advisories or recommended preparation will not require validation but are recommendations to be considered by the student prior to enrolling.

Course Objectives: *At the conclusion of this course, the student should be able to:*

1. describe the fundamental principles of information technology security.
2. define the concepts of threat, evaluation of assets, information assets, physical, operational, and information security and how they are related.
3. evaluate the need for the careful design of a secure organizational information infrastructure.
4. perform risk analysis and risk management.
5. determine both technical and administrative mitigation approaches.
6. explain the need for a comprehensive security model and its implications for the security manager or Chief Security Officer (CSO).
7. create and maintain a comprehensive security model.
8. apply security technologies.
9. define basic cryptography, its implementation considerations, and key management.
10. design and guide the development of an organization's security policy
11. determine appropriate strategies to assure confidentiality, integrity, and availability of information.
12. apply risk management techniques to manage risk, reduce vulnerabilities, threats, and apply appropriate safeguards/controls.

Methods of Evaluation:

Evaluation will include hands-on projects and a combination of examinations, presentations, discussions, or problem-solving assignments.

Sample Textbooks, Manuals, or Other Support Materials (do not include editions or publication dates):

- Wheeler, E. - Security Risk Management: Building an Information Security Risk Management Program from the Ground Up
- Whitman, M. E. & Mattord, H. J. - Principles of Information Security
- Linkies, M. & Karin, H. - SAP Security and Risk Management

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