TENNESSEE DEPARTMENT OF EDUCATION
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# Cabling & Internetworking

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| **Primary Career Cluster:** | Information Technology |
| **Consultant:** | Bethany King Wilkes, (615) 532-2844, Bethany.Wilkes@tn.gov |
| **Course Code(s):** | 6093 |
| **Prerequisite(s):** | Algebra I (6109/3102) and Networking (6097) |
| **Credit:** | 1 |
| **Grade Level:** | 12 |
| **Graduation Requirements:** | This course satisfies one of three credits required for an elective focus when taken in conjunction with other Information Technology courses. |
| **Programs of Study and Sequence:** | This is the fourth, and final, course in the *Networking Systems* program of study. |
| **Necessary Equipment:** | Cutting tools, termination tools, crimp tools, fish tape, push/pull rod devices, and troubleshooting tools. |
| **Aligned Student Organization(s):** | Skills USA: www.tnskillsusa.com<br>Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov<br>Technology Student Association (TSA): www.tntsa.org<br>Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov |
| **Coordinating Work-Based Learning:** | If a teacher has completed work-based learning training, appropriate student placement can be offered. To learn more, visit http://tennessee.gov/education/cte/wb/. |
| **Available Student Industry Certifications:** | CompTIA Network+<br>CISCO Certified Networking Associates |
| **Dual Credit or Dual Enrollment Opportunities:** | There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement. |
| **Teacher Endorsement(s):** | 311, 435, 436, 475, 476, 582, 595 |
| **Required Teacher Certifications/Training:** | CompTIA Network+ (NetPlus) or CISCO Industry Certification |
| **Teacher Resources:** | www.tennessee.gov/education/cte/InformationTechnology.shtml |

## Course Description

*Cabling & Internetworking* is an advanced course intended to equip students with the conceptual and practical skills necessary to install voice and data network cabling. This course emphasizes industry standards, types of media and cabling, physical and logical networks, and signal transmission. Upon completion of this course, students will have skills in cable termination, reading network design

documentation, pulling and mounting cable, setting up telecommunications rooms, basic cable testing and troubleshooting. Standards in this course are aligned with Tennessee Common Core State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee Common Core State Standards in Mathematics.*

## Program of Study Application

This course is the fourth course in the *Networking Systems* program of study. For more information on the benefits and requirements of implementing this program in full, please see the program of study description documents found on the Information Technology website at http://www.tennessee.gov/education/cte/InformationTechnology.shtml.

## Course Standards

**Cabling Overview**

1) Research the history and development of communications cabling to acquire knowledge of present-day network cabling concepts and uses, including but not limited to:
    a. The history of telephone and wireless communications in the United States
    b. The differences between analog and digital communication systems
    c. The three main types and typical applications of twisted-pair cabling
    d. Proper uses of plenum- and riser-rated cabling

    Create and deliver a brief presentation on at least one of the above topics, citing specific textual evidence. (TN CCSS Reading 1, 2, 4, 7; TN CCSS Writing 4, 6, 9)

**Safety**

2) Assess a variety of situations requiring the use of network cabling and demonstrate the ability to follow procedures safely. Explain the applicability of various safety standards and procedures, including but not limited to:
    a. Safety codes and standards for the cabling materials and installation methods
    b. Safe practices working around electricity
    c. Workplace safety practices
    d. Personal safety equipment

    (TN CCSS Reading 3, 4, 6; TN CCSS Writing 4)

**Computers and Electronics**

3) Compare and contrast aspects of communication signals carried by various types of cabling, identifying which types are best suited for different applications. Complete a graphic organizer to differentiate characteristics of:
    a. Analog signals versus digital signals
    b. Voltage signals versus optical signals
    c. Multiplexed signals

    Craft an argument on which type of signal is best suited for a specific application, developing both claim(s) and counterclaim(s) with fair evidence and reasoning. (TN CCSS Reading 4, 7, 9; TN CCSS Writing 1, 4)

**Transmission Media**

4) Compare and contrast the typical applications for various types of data cables (such as twisted pair, coaxial cable, fiber optic), and the conditions under which a technician may use them. Defend the choice of cable for an example application, coherently and respectfully expressing the rationale behind the choice to a mock customer. (TN CCSS Reading 4; TN CCSS Writing 1, 4)

5) Compare and contrast conducting data cables with fiber-optic data cables, including but not limited to:
    a. Transmission modes (electrical conduction versus optical transmission)
    b. Connectors
    c. Installation issues
    d. Advantages and disadvantages

    (TN CCSS Reading 1)

**Specifications and Standards**

6) Research wiring standards and the organizations responsible for drafting and overseeing them. During a practice installation, explain how the communication of the standards impacts a user's ability to specify, install, and test the appropriate cabling. The subject organizations should include:
    a. American National Standards Institute (ANSI)
    b. Telecommunications Industry Association (TIA)
    c. Electronics Industries Alliance (EIA)

    (TN CCSS Reading 1, 3, 6)

7) During a practice installation of data cabling, describe the applicability of the National Electrical Code (NEC) and Underwriters Laboratories (UL) requirements, citing specific textual evidence. (TN CCSS Reading 1, 3, 6; TN CCSS Writing 4)

**Cabling System Design**

8) Design a telecommunications closet (TC) for a Local Area Network (LAN) installation. Craft a full explanatory text that cites specific textual evidence in descriptions of:
    a. Differences between TC and equipment rooms
    b. Recommended number of TCs in a large building
    c. TC construction standards (including required and prohibited features and dimensions)
    d. Typical equipment and features in TC
    e. Required environmental conditions inside the TC

    (TN CCSS Reading 1, 7; TN CCSS Writing 2, 4; TN CCSS Math N-Q, A-SSE, A-CED)

9) Explain and demonstrate, in writing or a presentation, the role played by each component in a typical star network installation, including the Network Interface card (NIC), media converter, repeater, hub, bridge, switch, server, and router. For each component, detail the likely consequences in the event of failure, and prescribe strategies for prevention and maintenance. (TN CCSS Reading 3, 4, 7; TN CCSS Writing 2, 4, 6; TN CCSS Math N-Q, A-SSE)

**Cabling Installations**

10) Plan and implement a small-scale LAN installation, properly using the tools, techniques, and materials accepted in cabling industry, including but not limited to building schematics, wire cutters and wire strippers, cable crimpers, punch-down tool, "fish tape" and pull/pushrods, diagnostic test tools, lubricants, and cable identification tags. Before completing installation, design a summary document that includes a narrative of activities and a graphic illustration of sites to share with potential customer. (TN CCSS Reading 3, 7; TN CCSS Writing 2, 4, 7; TN CCSS Math N-Q, A-SSE, G-GMD, G-MG)

11) As part of a real or practice installation, explain and demonstrate the rough-in phase for both horizontal and vertical installations of data cabling in a small office, including but not limited to horizontal and vertical installations, fire stops, and telecommunications closet construction or upgrades. (TN CCSS Reading 3, 4, 5, 7, 8; TN CCSS Writing 2, 4, 6; TN CCSS Math N-Q, A-SSE, G-SRT, G-GMD, G-MG)

12) As part of a real or practice installation, explain and demonstrate the trim-out phase of an installation, including but not limited to cable management, connectors and splices for copper media and fiber-optic media, and patch panels. (TN CCSS Reading 3, 4, 5, 7, 8; TN CCSS Writing 2, 4, 5, 6; TN CCSS Math N-Q, A-SSE)

13) As part of a real or practice installation, explain and demonstrate the completion stage of an installation, including but not limited to cable testing and certification, performance testing, final dressing of the installation, and documentation and drawings representing the finished installation and test results. (TN CCSS Reading 3; TN CCSS Writing 4; TN CCSS Math N-Q, A-SSE)

**Special Cabling Situations**

14) Demonstrate an understanding of the special cabling situations required for high bandwidth scenarios, providing power over Ethernet (PoE), standards of SCADA systems, industrial-grade data cabling requirements, and preventive maintenance programs for cable systems. Create and deliver a brief presentation on at least one of the above topics, citing specific textual evidence. (TN CCSS Reading 1, 3, 4; TN CCSS Writing 4, 6, 8)

## Standards Alignment Notes

*References to other standards include:

- TN CCSS Reading: Tennessee Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN CCSS Writing: Tennessee Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).

    - Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, and 10 at the conclusion of the course.
- TN CCSS Math: Tennessee Common Core State Standards for Mathematics: Math Standards for High School: Number and Quantity, Algebra, Geometry (pages 58-83).
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students that are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

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# Programming & Logic I

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|---|---|
| **Primary Career Cluster:** | Information Technology |
| **Consultant:** | Bethany King Wilkes, (615) 532-2844, Bethany.Wilkes@tn.gov |
| **Course Code(s):** | 6098 |
| **Prerequisite(s):** | Algebra I (6109/3102), Information Technology Foundations (6095) |
| **Credit:** | 1 |
| **Grade Level:** | 10 |
| **Graduation Requirements:** | This course satisfies one of three credits required for an elective focus when taken in conjunction with other Information Technology courses. |
| **Programs of Study and Sequence:** | This is the second course in the *Programming & Software Development* program of study. |
| **Necessary Equipment:** | Computer laboratory |
| **Aligned Student Organization(s):** | Skills USA: www.tnskillsusa.com<br>Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov<br>Technology Student Association (TSA): www.tntsa.org<br>Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov |
| **Coordinating Work-Based Learning:** | If a teacher has completed work-based learning training, an appropriate student placement can be offered. To learn more, visit http://tennessee.gov/education/cte/wb/. |
| **Available Student Industry Certifications:** | None |
| **Dual Credit or Dual Enrollment Opportunities:** | There are no known dual credit/dual enrollment opportunities for this course. If you are interested in developing, reach out to your local postsecondary institution to establish an articulation agreement. |
| **Teacher Endorsement(s):** | 516, 519, 520, 521, 543, 576, 583 |
| **Required Teacher Certifications/Training:** | None |
| **Teacher Resources:** | www.tennessee.gov/education/cte/InformationTechnology.shtml |

## Course Description

*Programming & Logic I* is a course intended to teach students the basics of computer programming. The course places emphasis on practicing standard programming techniques and learning the logic tools and methods typically used by programmers to create simple computer applications. Upon completion of this course, students proficient in programming and logic can solve problems by planning multistep procedures. They are able to write, analyze, review, and revise programs, converting detailed

information from workflow charts and diagrams into coded instructions in a computer language. Students completing this course will be able to troubleshoot/debug programs and software applications to correct malfunctions and ensure their proper execution. Standards in this course are aligned with the Tennessee Common Core State Standards for English Language Arts Standards and Literacy in Technical Subjects and Tennessee Common Core State Standards for Mathematics.*****

## Program of Study Application

This course is the second course in the *Programming & Software Development* program of study. For more information on the benefits and requirements of implementing this program in full, please see the program of study description documents found on the Information Technology website at www.tennessee.gov/education/cte/InformationTechnology.shtml.

## Course Standards

**Computer Programming Overview**

1) Using news articles and instructional materials, investigate key milestones in the development of computers and logical devises. Create and present a document and/or illustration depicting the timeline of development that led to modern-day operating systems, programmable controllers, and widespread digital communications via the Internet and wireless networks, citing specific textual evidence. (TN CCSS Reading 1, 2; TN CCSS Writing 2, 4)

2) Compare and contrast the benefits, features, and typical applications of common modern programming languages and environments. Craft an argument to defend the choice of a certain language to solve a particular problem, developing claim(s) and counterclaim(s) with specific textual evidence and reasoning. (TN CCSS Reading 1, 2, 4, 5; TN CCSS Writing 1, 4)

**Ethics**

3) Using news articles and text of legislation, analyze ethical programming practices, including but not limited to the issues of confidentiality, privacy, piracy, fraud and misuse, liability, copyright, open source software, trade secrets, and sabotage. For example, research and report on the effects of unethical programming practices on a business. (TN CCSS Reading 1, 2; TN CCSS Writing 7)

**Programming Skills**

4) Differentiate between system-level and application solutions, and identify an appropriate code-based strategy to solve a given problem. For example, given a file management problem, determine when a command-line script will be more efficient than a high-level program solution. (TN CCSS Reading 4, 5; TN CCSS Math N-Q, A-SSE, F-IF)

5) Apply the system management tools present in a programming development environment to:
    a. Select the most appropriate programming language for the task at hand

b. Develop syntactically correct program code using current best practices and emerging classes of development techniques
c. Use a compiler to interpret the source code and produce executable program code

(TN CCSS Reading 3, 4, 5; TN CCSS Writing 4)

6) In the process of developing and implementing programming solutions, develop strategies that work within the constraints of major operating system fundamentals, such as:
    a. Security protocols and procedures for accessing files and folders
    b. File management syntax requirements, including but not limited to creating, naming, organizing, copying, moving, and deleting files
    c. File naming conventions, as they apply across multiple software applications and file types.

    (TN CCSS Reading 3, 4; TN CCSS Writing 6)

7) Write pseudocode and construct a flowchart for a process before starting to develop the program code. For example, code and flowchart a simple process that takes an integer and report whether it is odd or even.

8) Organize and develop a plan to acquire and manage the data values for a process, including the following:
    a. Data types, such as string, numeric, character, integer, and date
    b. Program variable names
    c. Variables and constants
    d. Arrays (at least one- and two-dimensional), subscripts
    e. Input from files and user responses
    f. Output to files and reports

    (TN CCSS Reading 5)

9) Using a programming language specified by the instructor, convert the pseudocode for a selected process to program code, incorporating at least three of the following structures, the need for which will be dictated by the assigned problem(s) and process(es). The resulting code design can be event-driven, object-oriented, or procedural.
    a. Operations and functions (user-defined and/or library)
    b. Repetition (loops)
    c. Decision (if…else, case)
    d. Recursion

    (TN CCSS Reading 3; TN CCSS Writing 4)

10) Verify the correct operation of the resulting program code with several test cases:
    a. All valid values
    b. Error trapping of invalid values
    c. Error trapping of invalid program operation

d. Troubleshooting/remedying program problems

**Project Planning and Quality Assurance**

11) Compile the necessary documentation to understand the nature of a computer programming problem and the customer/client specifications for the request and summarize in an informational text. This will include evidence of the scope of the problem, its attendant input and output information, the required system processing, and the software specifications involved. (TN CCSS Reading 1, 2, 3,; TN CCSS Writing 2, 8)

12) Analyze a given problem and develop a coherent strategy in the form of a project plan to meet the customer/client's need. The plan will include, but will not be limited to, defining the project scope as addressed by the problem documentation, identifying software development and implementation issues, timeline and benchmarks for design, and addressing issues associated with software maintenance and life cycle. (TN CCSS Reading 1, 2; TN CCSS Writing 2, 8)

13) In the software development process, articulate the nature of the program designs by creating documentation that addresses topics including but not limited to:
    a. The procedural, object-oriented, event-driven, or other nature of the various portions of the resulting application
    b. The data structures used for inputs, outputs, and internal manipulations
    c. The algorithms and guiding formulas used
    d. Constraints on accurate operation and results
    e. Modular designs that enable portability
    f. Interface details that permit ready maintenance and upkeep

    (TN CCSS Reading 6; TN CCSS Writing 2, 6)

14) Apply principles of quality assurance during application development to certify bug tracking, audit trails, testing results, and other quality considerations. Annotate each quality assurance task with evidence from best practices endorsed by industry or research. (TN CCSS Reading 3, 6; TN CCSS Writing 7)

15) Document the security risks associated with new applications and evaluate the severity of the risk involved in each, including but not limited to:
    a. Identifying threats to information systems facilities, data communications systems, and other applications
    b. Adhering to federal and state legislation pertaining to computer crime, fraud, and abuse
    c. Providing means for preserving confidentiality and encryption of sensitive data
    d. Detailing steps to recover from routine errors or catastrophic failures, such as might be caused by a malicious computer virus

    (TN CCSS Reading 8; TN CCSS Writing 1, 4)

## Standards Alignment Notes

*References to other standards include:

- TN CCSS Reading: Tennessee Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
    - Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, 9 and 10 at the conclusion of the course.
- TN CCSS Writing: Tennessee Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students that are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 9 and 10 at the conclusion of the course.
- TN CCSS Math: Tennessee Common Core State Standards for Mathematics: Math Standards for High School: Number and Quantity, Algebra, and Functions (pages 58-83).
    - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students that are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and functional reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
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