



# Networking





**Office of the State Superintendent of Education  
Postsecondary and Career Education Division  
Career and Technical Education Department**

The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Networking Program of Study, which includes the following courses: Principles of Information Technology, Networking I, Networking II, and Practicum in Information Technology: Networking. The academic standards in this document are theoretical and performance-based. They contain content from the states of Colorado, Maryland, Tennessee, and Texas and were validated by DC business and industry partners. All content is used with permission.

In addition to academic standards, OSSE has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; and, Work-Based Learning resources and requirements by course level.

This document is intended for use by educational administrators and practitioners. A similar document is available for each state-approved CTE Program of Study.

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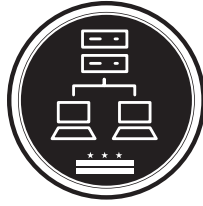
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## Networking Program of Study

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## Networking Program of Study

| Level I Course   | Level II Course                        | Level III Course                        | Level IV Course   |
|--|--|---|---|
| <b>Principles of Information Technology</b><br>OSSEID: 5110301 | <b>Networking I</b><br>OSSEID: 5110302 | <b>Networking II</b><br>OSSEID: 5110303 | <b>Practicum in Information Technology: Networking</b><br>OSSEID: 5110304 |

### **Principles of Information Technology (OSSEID: 5110301)**

**Grades:** 9-12

**Prerequisite:** None

**Description:** In Principles of Information Technology, students will develop computer literacy skills to adapt to emerging technologies used in the global marketplace. Students will implement personal and interpersonal skills to prepare for a rapidly evolving workplace environment. Students will enhance reading, writing, computing, communication, and reasoning skills and apply them to the information technology environment.

### **Networking I (OSSEID: 5110302)**

**Grades:** 10-12

**Prerequisite:** Principles of Information Technology

**Description:** The Networking I course is normally comprised of the courses called Cisco CCNA R&S: Introduction to Networks (CCNA 1) and Cisco CCNA R&S: Routing and Switching Essentials (CCNA 2). The Introduction to Networks course introduces the concept of networking, using various analogies to help the student understand the movement of packets throughout the Internet, and the protocol standards used. The Routing and Switching course moves the student into the theory of “moving packets.” The concepts of routing and switching “packets” to the correct destination is covered, and how a network administrator can direct and/or streamline this process through device configuration and deployment.

### **Networking II (OSSEID: 5110303)**

**Grades:** 11-12

**Prerequisite:** Networking I

**Description:** The Networking II course is normally comprised of the courses called Cisco CCNA R&S: Scaling Networks (CCNA 3) and Cisco CCNA R&S: Connecting Networks (CCNA 4). The CCNA 3 course covers the architecture, components, and operations of routers and switches in larger and more complex networks. Students learn how to configure routers and switches for advanced functionality. The CCNA 4 course discusses the Wide Area Network (WAN) technologies and network services required by converged applications in a complex network. The course enables students to understand the selection criteria of network devices and WAN technologies to meet network requirements.

### **Practicum in information Technology: Networking (OSSEID: 5110304)**

**Grades:** 12

**Prerequisite:** Networking II

**Description:** In the Practicum in Information Technology, students will gain advanced knowledge and skills in the application, design, production, implementation, maintenance, evaluation, and assessment of products, services, and systems. Knowledge and skills in the proper use of analytical skills and application of IT concepts and standards are essential to prepare students for success in a technology-driven society. Critical thinking, IT experience, and product development may be conducted in a classroom setting with an industry mentor, as an unpaid or paid internship, as part of a capstone project, or as career preparation.

## Industry Certifications

### At the end of Networking

Cisco Certified Entry Network Technician (CCENT)

### At the end of Networking II

Interconnecting Cisco Networking Devices: Accelerated (CCNAX)

Interconnecting Cisco Networking Devices Part 1 (ICND1)

Interconnecting Cisco Networking Devices Part 2 (ICND2)

## Work-Based Learning Examples and Resources

| Level I Course  | Level II Course   | Level III Course  | Level IV Course   |
|---|---|---|---|
| <b>Career Exploration</b><br>Industry Visits<br>Guest Speakers<br>Participate in a CTSO | <b>Career Awareness</b><br><i>All of Level I, plus:</i><br>Postsecondary Visits<br>Program-Specific Site Tours<br>Mock Interviews | <b>Career Preparation</b><br><i>All of Level I and II, plus:</i><br>Job Shadow<br>Paid/Unpaid Internships | <b>Career Preparation</b><br>Paid/Unpaid Internships<br>Apprenticeships |

Several resources are available to help instructors meet the Level I and Level II WBL requirements, including:

**Career Coach DC** (<http://careercoachdc.emsicc.com>). Online site designed to help students find and connect to a career pathway by providing the most current local data on wages, employment, job postings, and associated education and training. Resource includes a Career Assessment for students.

**Nepris** (<https://www.nepris.com>). Connects educators and learners with a network of industry professionals, virtually, bringing real-world relevance and career exposure to all students. Nepris also provides a skills-based volunteering platform for business and industry professionals to extend their educational outreach.

**Virtual Job Shadow** (<https://virtualjobshadow.com>). Provides interactive tools which empower students to discover, plan, and pursue their dreams. Rich video library presents a “day in the life of” view for thousands of occupations.

## Labor Market Information Definitions and Data

Career and Technical Education programs of study in the District of Columbia must meet at least one of the High Wage, High Skill, and In Demand definitions, below, to be considered as appropriate for our students and regional labor market. These definitions were created in collaboration with Career and Technical Education leaders from District of Columbia LEA’s, the University of the District of Columbia Community College, and national guidance from Research Triangle International (RTI) and Education Northwest. Additionally, previous work was consulted from researchers at MIT’s Labor Wage Index Project and the DC CTE Task Force’s 2012 Strategic Plan for the District of Columbia.

**High Wage:** Those occupations that have a 25<sup>th</sup> percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the District of Columbia, and/or leads to a position that pays at least the median hourly or annual wage for the Washington, DC, metropolitan statistical area. *(Note: A 25<sup>th</sup> percentile hourly wage of \$17.02 or greater is required to meet this definition).*

**High Skill:** Those occupations located within the Washington, DC, metropolitan statistical area with education or training requirements of: completion of an apprenticeship program; completion of an industry recognized certification or credential; associate’s degree, or higher.

**In Demand:** Those occupations in the Washington, DC, metropolitan statistical area having more than the median number of total (growth plus replacement) annual openings over a five-year period. *(Note: An occupation is required to have an annual growth plus replacement rate of 105 openings, or greater, between 2020-25 to meet this definition).*

**Data for the Networking Program of Study** *(source: EMSI, August 2019):*

**Standard Occupational Code (SOC):** 15.1143.00—Computer Network Architect

**Hourly Wages**

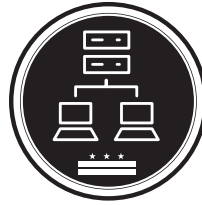
25<sup>th</sup> Percentile: \$46.09

50<sup>th</sup> Percentile: \$60.87

75<sup>th</sup> Percentile: \$75.76

**Annual Openings (Growth and Replacement):** 1,195

**Typical Entry Level Education:** Bachelor’s Degree



## Model Six-Year Plan: Networking Program of Study

**College:** University of the District of Columbia Community College

**Program/CIP:**

**Plan:**

**Entity:** Office of the State Superintendent of Education

**Career Cluster:** Information Technology

**Program of Study:** Networking

| Subject  | High School                                |  |                        |   | College  |             |              |             |
|--|--|--|------------------------|---|--|-------------|--------------|-------------|
|  | 9 <sup>th</sup> Grade                      | 10 <sup>th</sup> Grade                       | 11 <sup>th</sup> Grade | 12 <sup>th</sup> Grade                          | Semester I   | Semester II | Semester III | Semester IV |
| <b>English (4)</b>   | English I                                  | English II                                   | English III            | English IV                                      |  |             |              |             |
| <b>Math (4)</b>  | Algebra I                                  | Geometry                                     | Algebra II             | Math  |  |             |              |             |
| <b>Science (4)</b>   | Biology                                    | Lab Science                                  | Lab Science            | Science   |  |             |              |             |
| <b>Social Studies (4)</b>  | World History and Geography I: Middle Ages | World History and Geography II: Modern World | U.S. History           | U.S. Government (.5) and DC History (.5)        |  |             |              |             |
| <b>Health (.5) and Physical Ed (1)</b>                             | Health (.5)<br>Physical Ed (.5)            | Physical Ed (.5)                             |                        |   |  |             |              |             |
| <b>World Languages (2)</b>   |  |  | World Language I       | World Language II                               |  |             |              |             |
| <b>Art (.5)</b>  |  | Art (.5)                                     |                        |   |  |             |              |             |
| <b>Music (.5)</b>  |  | Music (.5)                                   |                        |   |  |             |              |             |
| <b>Elective / Major Courses</b>                                    | Principles of Information Technology       | Networking I                                 | Networking II          | Practicum in Information Technology: Networking |  |             |              |             |
| <b>Total possible college credits completed in high school: XX</b> |  |  |                        |   | <b>Credit hours required to complete the AAS program: XX</b> |             |              |             |

# Principles of Information Technology

(a) **General requirements.** This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successful completion of this course.

(b) **Introduction.**

- (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
- (2) The Information Technology (IT) Career Cluster focuses on building linkages in IT occupations for entry level, technical, and professional careers related to the design, development, support, and management of hardware, software, multimedia, and systems integration services.
- (3) In Principles of Information Technology, students will develop computer literacy skills to adapt to emerging technologies used in the global marketplace. Students will implement personal and interpersonal skills to prepare for a rapidly evolving workplace environment. Students will enhance reading, writing, computing, communication, and reasoning skills and apply them to the information technology environment.
- (4) Students will participate in at least two Career Exploration Work-Based Learning experiences in this course, which might include guest speakers and work-place tours relevant to the program of study.
- (5) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(c) **Knowledge and skills.**

(1) **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**

- (A) identify and demonstrate work behaviors and qualities that enhance employability and job advancement such as regular attendance, attention to proper attire, maintenance of a clean and safe work environment, pride in work, flexibility, and initiative;
- (B) employ effective verbal and nonverbal communication skills;
- (C) employ effective reading and writing skills;
- (D) solve problems and think critically;
- (E) demonstrate leadership skills and function effectively as a team member;
- (F) identify and implement proper safety procedures; and
- (G) demonstrate planning and time-management skills such as storyboarding and project management, including initiating, planning, executing, monitoring and controlling, and closing a project.

(2) **The student identifies various employment opportunities in the IT field. The student is expected to:**

- (A) identify job opportunities and accompanying job duties and tasks;
- (B) research careers of personal interest along with the education, job skills, and experience required to achieve personal career goals; and
- (C) describe the functions of resumes and portfolios.

(3) **The student uses evolving and emerging technologies to exchange information. The student is expected to:**

- (A) identify and describe functions of various evolving and emerging technologies;
- (B) send and receive text information and file attachments using electronic methods such as email, electronic bulletin boards, and instant message services;
- (C) demonstrate effective Internet search strategies, including keywords and Boolean logic, using various available search engines;

- (D) identify the various components of a Uniform Resource Locator;
  - (E) demonstrate ability to effectively test acquired information from the Internet for accuracy, relevance, and validity;
  - (F) explain issues concerning computer-based threats such as computer viruses, malware, and hacking; and
  - (G) explain issues concerning Internet safety such as identity theft, online predators, cyber-bullying, and phishing.
- (4) **The student demonstrates knowledge of the hardware components associated with information systems. The student is expected to:**
- (A) identify major hardware components and their functions;
  - (B) use available reference tools as appropriate; and
  - (C) connect and use a variety of peripheral devices such as mouse, keyboard, microphone, digital camera, and printer.
- (5) **The student demonstrates knowledge of the different software associated with information systems. The student is expected to:**
- (A) differentiate between systems and application software;
  - (B) identify and explain major operating system fundamentals and components such as disk operations, graphical user interface components, and hardware drivers;
  - (C) explain the purpose of file types across software products;
  - (D) demonstrate use of computer numbering systems and internal data representation such as identifying the hexadecimal value of a color;
  - (E) compare and contrast open source and proprietary software;
  - (F) explain use of system management tools;
  - (G) apply proper file management techniques such as creating, naming, organizing, copying, moving, and deleting files;
  - (H) use appropriate file protection and security; and
  - (I) explain the process for discovering, quarantining, and removing viruses from a computer system.
- (6) **The student analyzes network systems. The student is expected to:**
- (A) identify hardware associated with telecommunications and data networking such as servers, routers, switches, and network connectors;
  - (B) identify and describe various types of networks such as peer-to-peer, local area networks, wide area networks, wireless, and Ethernet;
  - (C) identify functions of network operating systems; and
  - (D) explain troubleshooting techniques for various network connection issues.
- (7) **The student applies word-processing technology. The student is expected to:**
- (A) identify the terminology associated with word-processing software;
  - (B) edit a variety of text documents using functions such as pagination, appropriate white space, tab settings, and font style, size, and color; and
  - (C) create professional documents such as memorandums, technical manuals, or proposals using advanced word-processing features.
- (8) **The student applies spreadsheet technology. The student is expected to:**
- (A) identify the terminology associated with spreadsheet software;
  - (B) use numerical content to perform mathematical calculations;
  - (C) use student-created and preprogrammed functions to produce documents such as budget, payroll, statistical tables, and personal checkbook register;



- (D) identify, generate, and describe the function of comma separated value files;
- (E) create and analyze spreadsheets incorporating advanced features such as lookup tables, nested IF statements, subtotals, cell protection conditional formatting, charts, and graphs; and
- (F) perform sorting, searching, and data filtering in documents.

**(9) The student explores computer programming concepts. The student is expected to:**

- (A) identify the function of compilers and interpreters;
- (B) explain the difference between the operation of compilers and interpreters;
- (C) identify various computer languages and how the languages are used in software development;
- (D) recognize data representation in software development such as string, numeric, character, integer, and date;
- (E) identify and explain the concept of algorithms; and
- (F) describe the flow of a structured algorithm, including linear and iterative instructions such as using a flow chart.

**(10)The student explores database technology. The student is expected to:**

- (A) identify the terminology associated with database software and database functions;
- (B) explore the application of databases;
- (C) identify and explain the purpose and elements of a query language;
- (D) identify and explain the purpose of fields and records; and
- (E) describe the process of constructing a query, including multiple search parameters.

**(11)The student applies presentation management technology. The student is expected to:**

- (A) identify the terminology and functions of presentation software; and
- (B) create, save, edit, and produce presentations incorporating advanced features such as links, hyperlinks, audio, and graphics.

**(12)The student applies design and web publishing techniques. The student is expected to:**

- (A) identify the terminology associated with web page development and interactive media;
- (B) identify and explain design elements such as typeface, color, shape, texture, space, and form;
- (C) identify and explain design principles such as unity, harmony, balance, scale, and contrast;
- (D) identify and explain common elements of Hyper Text Markup Language (HTML) such as tags, stylesheets, and hyperlinks; and
- (E) create a web page containing links, graphics, and text using appropriate design principles.

**(13)The student understands and demonstrates legal and ethical procedures as they apply to the use of information technology. The student is expected to:**

- (A) explain and demonstrate ethical use of technology and online resources;
- (B) adhere to intellectual property laws;
- (C) explain the concept of intellectual property laws, including copyright, trademarks, and patents and consequences of violating each type of law;
- (D) examine the consequences of plagiarism;
- (E) identify and explain unethical practices such as hacking, online piracy, and data vandalism; and
- (F) demonstrate ethical use of online resources, including citation of source.

*Standards for Career and Technical Education courses in the District of Columbia contain, in whole or in part, content from the states of Colorado, Maryland, Tennessee, and Texas, and were validated by DC business and industry partners. All content is used with permission.*

# Networking I

- (a) **General requirements.** This course is recommended for students in Grades 10-12. Prerequisites: Principles of Information Technology.
- (b) **Introduction.**
- (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
  - (2) The Information Technology (IT) Career Cluster focuses on building linkages in IT occupations for entry level, technical, and professional careers related to the design, development, support, and management of hardware, software, multimedia, and systems integration services.
  - (3) The Networking I course is normally comprised of the courses called Cisco CCNA R&S: Introduction to Networks (CCNA 1) and Cisco CCNA R&S: Routing and Switching Essentials (CCNA 2). The Introduction to Networks course introduces the concept of networking, using various analogies to help the student understand the movement of packets throughout the Internet, and the protocol standards used. The Routing and Switching course moves the student into the theory of “moving packets.” The concepts of routing and switching “packets” to the correct destination is covered, and how a network administrator can direct and/or streamline this process through device configuration and deployment.
  - (4) Students will participate in at least two Career Awareness Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
  - (5) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
- (c) **Knowledge and skills**
- (1) **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
    - (A) identify and demonstrate positive work behaviors that enhance employability and job advancement such as regular attendance, promptness, attention to proper attire, maintenance of a clean and safe work environment, appropriate voice, and pride in work;
    - (B) identify and demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, listening attentively to speakers, and willingness to learn new knowledge and skills;
    - (C) employ effective reading and writing skills;
    - (D) solve problems and think critically;
    - (E) demonstrate leadership skills and function effectively as a team member;
    - (F) identify and implement proper safety procedures;
    - (G) demonstrate an understanding of legal and ethical responsibilities in relation to the field of information technology; and
    - (H) demonstrate planning and time-management skills.
  - (2) **The student identifies various employment opportunities in the information technology field. The student is expected to:**
    - (A) improve on a personal career plan along with education, job skills, and experience necessary to achieve career goals;
    - (B) develop a resume and portfolio appropriate to chosen career plan, including letters of recommendation; and
    - (C) illustrate interview skills for successful job placement.

- (3) **The student develops technology skills. The student is expected to:**
- (A) Use technology as a tool to research, organize, evaluate, and communicate information.
  - (B) Use digital technologies (computers, PDAs, media players, GPSs, etc.), communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy.
  - (C) Demonstrate utilizing current and new technologies specific to the program of study, course, and/or industry.
  - (D) Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.
- (4) **The student applies communication, mathematics, English language arts, and science knowledge and skills to research and develop projects. The student is expected to:**
- (A) demonstrate proper use of written, verbal, and visual communication techniques consistent with networking industry standards;
  - (B) demonstrate proper use of mathematics concepts in the development of networking technologies; and
  - (C) demonstrate proper use of science principles in the development of networking technologies.
- (5) **The student understands the operation of data networks. The student is expected to:**
- (A) describe the purpose and functions of various network devices;
  - (B) describe the components required for network and Internet communications;
  - (C) select the correct components required to meet a given network specification;
  - (D) describe the purpose and basic operation of the protocols in the Open Systems Interconnection (OSI) and Transmission Control Protocol (TCP) models and their associated protocols;
  - (E) describe the impact of common networking applications Voice Over Internet Protocol (VOIP) and Video Over IP (VIP) on a network;
  - (F) interpret network diagrams;
  - (G) predict the path between two hosts across a network; and
  - (H) differentiate between Local Area Networks/Wide-Area Networks (LAN/WAN) operation and features.
- (6) **The student configures, verifies and troubleshoots switching. The student is expected to:**
- (A) select the appropriate media, cables, ports, and connectors to connect switches to other network devices and hosts;
  - (B) explain the technology and media access control method for Ethernet technologies;
  - (C) explain network segmentation and basic traffic management concepts;
  - (D) explain the operation and concepts of basic switching;
  - (E) perform, save and verify initial switch configuration including Switched Virtual Interfaces (SVI) and Default Gateway;
  - (F) verify network status and switch operation using basic utilities;
  - (G) implement and verify basic security for a switch;
  - (H) identify, prescribe, and resolve common switched network media issues, configuration issues, auto negotiation, and switch hardware failures;
  - (I) describe the function and operation of Virtual Local Area Networks (VLANs); and
  - (J) configure, verify, and troubleshoot VLANs and trunking.
- (7) **The student implements Internet Protocol version 4 (IPv4) and Internet Protocol version 6 (IPv6) addressing schemes and services to meet network requirements. The student is expected to:**
- (A) describe the need and role of addressing in a network;
  - (B) compare and contrast IPv4 and IPv6;
  - (C) create and apply appropriate IP addressing schemes to a network;

- (D) assign and verify valid IP addresses to hosts, servers, and networking devices in a LAN environment;
- (E) explain the basic uses and operation of Network Address Translation (NAT) in IPv4;
- (F) describe and verify Domain Name Service (DNS) operation;
- (G) describe the operation and benefits of using private and public IPv4 addressing;
- (H) implement static and dynamic addressing services for hosts in a LAN environment; and
- (I) identify and correct IP addressing issues.

**(8) The student configures, verifies, and troubleshoots routing. The student is expected to:**

- (A) describe basic routing concepts;
- (B) describe the operation of routers;
- (C) compare and contrast methods of routing and routing protocols;
- (D) configure, verify, and troubleshoot routing protocols;
- (E) connect, configure, and verify operation status of a device interface;
- (F) verify device configuration and network connectivity using ping, traceroute, telnet, Secure Shell (SSH) or other utilities;
- (G) perform and verify routing configuration tasks for a static or default route given specific routing requirements;
- (H) manage Internetwork Operating System (IOS) and configuration files including save, edit, upgrade, backup, and restore;
- (I) implement password and physical security;
- (J) configure and verify interVLAN routing;
- (K) configure and verify Access Control Lists (ACLs);
- (L) configure and verify Domain Host Configuration Protocol (DHCP) and Network Address Translation (NAT); and
- (M) troubleshoot and correct network and configuration issues.

## Networking II

(a) **General requirements.** This course is recommended for students in Grades 11-12. Prerequisites: Networking I.

(b) **Introduction.**

- (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
- (2) The Information Technology (IT) Career Cluster focuses on building linkages in IT occupations for entry level, technical, and professional careers related to the design, development, support, and management of hardware, software, multimedia, and systems integration services.
- (3) The Networking II course is normally comprised of the courses called Cisco CCNA R&S: Scaling Networks (CCNA 3) and Cisco CCNA R&S: Connecting Networks (CCNA 4). The CCNA 3 course covers the architecture, components, and operations of routers and switches in larger and more complex networks. Students learn how to configure routers and switches for advanced functionality. The CCNA 4 course discusses the Wide Area Network (WAN) technologies and network services required by converged applications in a complex network. The course enables students to understand the selection criteria of network devices and WAN technologies to meet network requirements.
- (4) Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.
- (5) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(c) **Knowledge and skills**

- (1) **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
  - (A) identify and demonstrate positive work behaviors that enhance employability and job advancement such as regular attendance, promptness, attention to proper attire, maintenance of a clean and safe work environment, appropriate voice, and pride in work;
  - (B) identify and demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, listening attentively to speakers, and willingness to learn new knowledge and skills;
  - (C) employ effective reading and writing skills;
  - (D) solve problems and think critically;
  - (E) demonstrate leadership skills and function effectively as a team member;
  - (F) identify and implement proper safety procedures;
  - (G) demonstrate an understanding of legal and ethical responsibilities in relation to the field of information technology; and
  - (H) demonstrate planning and time-management skills.
- (2) **The student identifies various employment opportunities in the information technology field. The student is expected to:**
  - (A) improve on a personal career plan along with education, job skills, and experience necessary to achieve career goals;
  - (B) update or develop a resume and/or portfolio appropriate to chosen career plan, including letters of recommendation; and
  - (C) illustrate interview skills for successful job placement.

- (3) **The student develops technology skills. The student is expected to:**
- (A) Use technology as a tool to research, organize, evaluate, and communicate information.
  - (B) Use digital technologies (computers, PDAs, media players, GPSs, etc.), communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy.
  - (C) Demonstrate utilizing current and new technologies specific to the program of study, course, and/or industry.
  - (D) Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.
- (4) **The student applies communication, mathematics, English language arts, and science knowledge and skills to research and develop projects. The student is expected to:**
- (A) demonstrate proper use of written, verbal, and visual communication techniques consistent with networking industry standards;
  - (B) demonstrate proper use of mathematics concepts in the development of networking technologies;
  - (C) demonstrate proper use of science principles in the development of networking technologies.
- (5) **The student configures, verifies, and troubleshoots advanced switching. The student is expected to:**
- (A) describe enhanced switching technologies;
  - (B) configure, verify, and troubleshoot Spanning Tree versions;
  - (C) interpret the output of various show and debug commands to verify the operational status of a Cisco switched network; and
  - (D) implement basic switch security.
- (6) **The student configures, verifies, and troubleshoots advanced routing. The student is expected to:**
- (A) compare and contrast advanced routing protocols Enhanced Interior Gateway Routing Protocol (EIGRP) and Open Shortest Path First (OSPF);
  - (B) configure, verify, and troubleshoot routing protocols;
  - (C) troubleshoot routing implementation issues;
  - (D) verify router hardware and software operation using SHOW & DEBUG commands;
  - (E) manage Internetwork Operating System (IOS) files and licensing; and implement router security.
- (7) **The student implements and verifies Wide Area Network (WAN) links. The student is expected to:**
- (A) describe different methods for connecting to a WAN;
  - (B) configure and verify a basic WAN serial connection;
  - (C) configure and verify Point-to-Point Protocol (PPP);
  - (D) configure and verify Frame Relay; and
  - (E) implement and troubleshoot Point-to-Point Protocol over Ethernet (PPPoE).
- (8) **The student troubleshoots switching and routing networks. The student is expected to:**
- (A) analyze and implement proper troubleshooting methods;
  - (B) identify and correct switching and routing network problems;
  - (C) identify and select software troubleshooting tools;
  - (D) identify and correct routing protocol issues; and
  - (E) identify and correct WAN issues.

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## Practicum in Information Technology: Networking

- (a) **General requirements.** This course is recommended for students in Grade 12. The practicum course is a paid or unpaid capstone experience for students participating in a coherent sequence of career and technical education courses in the Information Technology Career Cluster. Prerequisite: Networking II. Students shall be awarded one credit for successful completion of this course.
- (b) **Introduction.**
- (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
  - (2) The Information Technology (IT) Career Cluster focuses on building linkages in IT occupations for entry level, technical, and professional careers related to the design, development, support, and management of hardware, software, multimedia, and systems integration services.
  - (3) In the Practicum in Information Technology, students will gain advanced knowledge and skills in the application, design, production, implementation, maintenance, evaluation, and assessment of products, services, and systems. Knowledge and skills in the proper use of analytical skills and application of IT concepts and standards are essential to prepare students for success in a technology-driven society. Critical thinking, IT experience, and product development may be conducted in a classroom setting with an industry mentor, as an unpaid or paid internship, as part of a capstone project, or as career preparation.
  - (4) Students will participate in a Career Preparation Work-Based Learning experience in this course, which includes paid or unpaid internship, pre-apprenticeship, or apprenticeship experiences relevant to the program of study.
  - (5) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
- (c) **Knowledge and skills.**
- (1) **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
    - (A) identify and demonstrate work behaviors that enhance employability and job advancement such as regular attendance, promptness, attention to proper attire, maintenance of a clean and safe work environment, appropriate voice, and pride in work;
    - (B) identify and demonstrate qualities such as flexibility, open-mindedness, initiative, listening attentively to speakers, and willingness to learn new knowledge and skills;
    - (C) employ effective reading and writing skills;
    - (D) employ effective verbal and nonverbal communication skills;
    - (E) solve problems and think critically;
    - (F) demonstrate leadership skills and function effectively as a team member;
    - (G) identify and implement proper safety procedures;
    - (H) demonstrate an understanding of legal and ethical responsibilities in relation to the field of IT; and
    - (I) demonstrate planning and time-management skills such as storyboarding and project management, including initiating, planning, executing, monitoring and controlling, and closing a project.
  - (2) **The student identifies various employment opportunities in the IT field. The student is expected to:**
    - (A) improve on a personal career plan along with education, job skills, and experience necessary to achieve career goals;

- (B) develop a resume that includes letters of recommendation and a portfolio appropriate to a chosen career plan; and
  - (C) illustrate interview skills for successful job placement.
- (3) **The student applies academic knowledge and skills to research and develop projects. The student is expected to:**
- (A) demonstrate proper use of written, verbal, and visual communication techniques consistent with IT industry standards;
  - (B) demonstrate proper use of mathematics concepts in the development of products or services; and
  - (C) demonstrate proper use of science principles in the development of products or services.
- (4) **The student selects an approach for conducting research to discover a problem in the field of IT with the appropriate supervision and guidance. The student is expected to:**
- (A) identify a problem relating to information technology; and
  - (B) describe and use an approach such as top-down or bottom-up for conducting a research activity.
- (5) **The student creates a technological solution for a problem in the field of IT. The student is expected to:**
- (A) apply critical-thinking strategies to develop a solution using appropriate technologies and resources, IT concepts, and industry standards;
  - (B) apply decision-making techniques to the selection of technological solutions; and
  - (C) explain how the proposed technological solution will resolve the problem.
- (6) **The student designs, creates, and implements a product or service that addresses a problem in the field of IT and incorporates the solution. The student is expected to:**
- (A) work closely with a mentor throughout the design, creation, and implementation process;
  - (B) develop a product or service that meets a specified need following a problem-solving strategy;
  - (C) identify areas where quality, reliability, and safety can be designed into a product or service;
  - (D) develop and implement a security management plan to address security requirements;
  - (E) develop a sustainability plan for the product or service;
  - (F) develop an evaluation method for analyzing the effect of the product or service on client satisfaction and problem resolution;
  - (G) develop a project portfolio that documents the research and development process; and
  - (H) present the portfolio to a panel of professionals using formal presentation skills.
- (7) **The student creates a personal portfolio. The student is expected to:**
- (A) create a portfolio that documents all projects and accomplishments such as academics, volunteer experience, employment experience, awards, and certifications;
  - (B) organize and prioritize information within the portfolio; and
  - (C) use written, verbal, and visual communication techniques consistent with IT industry standards.

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