North Dakota Information Technology Education

Content Standards

Approved and Adopted 2025

North Dakota Department of Career and Technical Education
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North Dakota Technical Education Team and Standards Process

This set of standards was reviewed by the North Dakota state IT teachers, with special thanks to:
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Adapted from Common Career and Technical Core, Career ClusterTM, Information Technology 2012, careertech.org.

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The Board policy does not advocate, permit, nor practice discrimination on the basis of sex, race, color, national origin, religion, age, or disability as required by various state and federal laws. Equal education opportunity is a priority of the North Dakota State Board for Career and Technical Education.

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Career and Technical Education Standards Introduction

Mission

The mission of the State Board for Career and Technical Education (CTE) is to work with others to provide all North Dakota citizens with the technical skills, knowledge, and attitudes necessary for successful performance in a globally competitive workplace.

Vision

The State Board for Career and Technical Education (CTE) is committed to providing career awareness, work readiness skills, occupational preparation, and retraining of workers throughout the state. Career and technical education will span all educational levels, providing youth with exploration opportunities and the foundation skills needed to enter the world of work while providing adults with skills needed to enter, re-enter, or advance in the workforce.

Goal

North Dakota Career and Technical Education's goal is to create a competitive and knowledgeable work force. This is accomplished through a variety of educational program areas that are organized to prepare students for careers in their chosen fields, to take leadership roles, and balance their multiple roles in life. CTE programs prepare students with the knowledge and skills to make informed career choices, to integrate and apply academic concepts, to prepare for successful participation in a global society, and to engage in lifelong learning.

Standards Development Process

Standards development is a multi-phase process. Existing and/or industry standards are the basis for the North Dakota Program Standards. A team of expert secondary and postsecondary teachers, business and industry representatives, and the state program supervisor draft the standards document. Once the document is finalized, the State Board for Career and Technical Education approves and adopts the standards.

Course Frameworks are also developed by the writing team. A framework includes a brief overview of the course content, topical units of study, and identifies the standards recommended for inclusion within the course. The frameworks are tailored to prepare young people for the opportunities in North Dakota. School Districts will use the frameworks as a guide for developing curriculum that reflects local needs.

Key Principles of Career and Technical Education

We believe that Career Technical Education:

1. **Draws its curricula, standards, and organizing principles from the workplace.**
   The workplace provides the context, objectives, and organizing constructs for instruction and assessment. The workplace also defines the standards of performance necessary, including those required for academic, technical, and employability skills.

2. **Is a critical and integral component of the total educational system, offering career-oriented benefits for all students.**
   CTE classes offer educational benefits to students pursuing careers requiring specific technical skills as well as providing a strong foundation for those pursuing a traditional four-year (or more) degree.

3. **Is a critical and integral component of the workforce development system, providing the essential foundation for a thriving economy.**
   Preparation of a well-prepared, qualified workforce requires solid academics, good work ethics, and specific technical skills as well as the ability to communicate, work with others, solve problems, and use information. CTE contributes directly to this preparation by providing a curriculum tied to specific workplace requirements.

4. **Maintains high levels of excellence supported through identification of academic and workplace standards, measurement of performance (accountability), and high expectations for participant success.**
   Career Technical Education is committed to continuous improvement, attention to industry certification, and the development of highly qualified teachers.

5. **Is robust and flexible enough to respond to the needs of the multiple educational environments, customers, and levels of specialization.**
   CTE involves a large and complex delivery system that (1) integrates career exploration, (2) provides effective tools for organizing all curricula, (3) facilitates the teaching and use of technology, (4) is integrated into the total learning experience, (5) enhances the learning of academic subjects, (6) teaches broad occupational skills, (7) includes all aspects of the industry, (8) teaches how to balance family and work responsibilities, (9) provides job-specific training, (10) is offered at multiple levels of the educational continuum, and (11) is delivered through a variety of educational environments.

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Standard 1	*INFORMATION TECHNOLOGY BASICS*	
Topic 1.1	**Summarize the process of IT product/service design.**	
	Student Competencies	
	1.1.1	Test products for reliability.
	1.1.2	Initiate predictive maintenance procedures.
	1.1.3	Demonstrate knowledge of the hardware components associated with information systems.
	1.1.4	Compare key functions and applications of software and determine maintenance strategies for computer systems.
Topic 1.2	**Identify and implement new products/services and new IT technologies.**	
	Student Competencies	
	1.2.1	Identify new technologies relevant to information technology.
	1.2.2	Plan for, create, and test new products/services for reliability.
	1.2.3	Maintain the reliability of new products/services.
	1.2.4	Assess the importance of new technologies to future developments and to future knowledge worker productivity.
	1.2.5	Identify new and emerging drivers and inhibitors of information technology change.
	1.2.6	Assess the potential importance and impact of new IT technologies in the future.
Topic 1.3	**Explain legal issues faced by IT professionals.**	
	Student Competencies	
	1.3.1	Demonstrate knowledge of the legal issues that face IT professionals.
	1.3.2	Identify issues and trends affecting computers and information privacy.
	1.3.3	Explain legal issues involved in a company security policy.
	1.3.4	Identify legal issues involved concerning a security breach.
	1.3.5	Summarize the rights and responsibilities of IT workers.
	1.3.6	Identify ethical issues common to the IT field.
Topic 1.4	**Demonstrate understanding of the impact of IT on businesses.**	
	Student Competencies	
	1.4.1	Demonstrate knowledge of how both PCs and larger computer systems impact people and are used in business/industry/government and other institutions.
	1.4.2	Demonstrate knowledge of the impact of computers on career pathways in business/industry (e.g., how computers have eliminated and created jobs).
	1.4.3	Demonstrate knowledge of the impact of computers on access to information and information exchange worldwide.
	1.4.4	Demonstrate knowledge of ethical issues that have surfaced in the information age.

Topic 1.5	**Explain the need for regular backup procedures and how to configure, perform, and maintain backup procedures.**	
	Student Competencies	
	1.5.1	Recognize the need for regular backup procedures.
	1.5.2	Load backup software.
	1.5.3	Load compression drive backup software.
	1.5.4	Install surge suppression protection.
	1.5.5	Identify battery backup equipment.
	1.5.6	Identify hot and warm site backup concepts.
Topic 1.6	**Assess security threats.**	
	Student Competencies	
	1.6.1	Describe potential security threats to information systems
	1.6.2	Identify the range of security needs and the problems that can occur due to security lapses.
	1.6.3	Maximize threat reduction.
	1.6.4	Assess exposure to security issues.
	1.6.5	Ensure compliance with security rules, regulations, and codes.
	1.6.6	Demonstrate knowledge of virus protection strategy.
	1.6.7	Implement security procedures in accordance with business ethics.
	1.6.8	Develop plans to address secure threats.
	1.6.9	Document security procedures.
Topic 1.7	**Implement plans to address security procedures.**	
	Student Competencies	
	1.7.1	Maintain confidentiality.
	1.7.2	Load virus detection and protection software.
	1.7.3	Identify sources of virus infections.
	1.7.4	Report viruses in compliance with company standards.
	1.7.5	Implement backup and recovery procedures.
	1.7.6	Follow disaster plan.
	1.7.7	Provide for user authentication and restricted access (e.g., assign passwords, access level).
Topic 1.8	**Summarize the elements of a quality management system.**	
	Student Competencies	
	1.8.1	Demonstrate knowledge of the control devices used in functional areas (e.g., SPC, equipment).
	1.8.2	Demonstrate knowledge of the relationship among organizational structures, policies, procedures, and quality assurance.
	1.8.3	Identify internal and external customers.
	1.8.4	Differentiate between prevention and detection.
	1.8.5	Differentiate between variable and attribute data.

	1.8.6	Identify types of control charts.
	1.8.7	Demonstrate knowledge of how statistical techniques are used to control quality (e.g., SPC, DOE, CR).
Topic 1.9	**Describe the role of and demonstrate the effective use of computer forensic investigation.**	
	Student Competencies	
	1.9.1	Define computer forensics.
	1.9.2	List some of the basic skills and knowledge a computer forensics specialist should possess.
	1.9.3	Identify the circumstances under which computer forensics evidence is typically used, who typically uses such evidence, and how it is used.
	1.9.4	Identify and attempt to retrieve possible evidence that may exist on a computer system.
	1.9.5	List what should and should not be done with the computer and evidence during an investigation.
Topic 1.10	**Identify criminal activity in relationship to cybercrime, the Internet, and Internet trafficking.**	
	Student Competencies	
	1.10.1	List common internet crimes.
	1.10.2	List some prevention actions related to cybercrime.
	1.10.3	Describe techniques to identify criminal activity.
	1.10.4	Identify how one files a complaint if a cybercrime is suspected or has occurred.

Standard 2		***INFORMATION SUPPORT AND SERVICES***
Topic 2.1	**Employ effective planning skills when working with client.**	
	Student Competencies	
	2.1.1	Identify support needs.
	2.1.2	Apply information and data analysis techniques.
	2.1.3	Identify skill level needs and available resources.
	2.1.4	Define scope of work to meet customer needs.
	2.1.5	Evaluate present data and system configuration.
	2.1.6	Formulate a support plan/confirm plan with client.
Topic 2.2	**Employ customer service principles/scientific method when working with consumers.**	
	Student Competencies	
	2.2.1	Respond to user questions and question customer.
	2.2.2	Provide troubleshooting/research of hardware/software.
	2.2.3	Analyze symptoms of problem and use diagnostic skills.
	2.2.4	Perform technical functions required by customer/user.
	2.2.5	Employ appropriate hardware and software tools to perform task in the most cost-effective manner.
	2.2.6	Employ effective problem-solving skills in performing support, maintenance and/or repair.
	2.2.7	Utilize effective field note techniques in documentation of technical support provided.
Topic 2.3	**Evaluate and follow-up on customer service provided.**	
	Student Competencies	
	2.3.1	When appropriate, follow up support session for evaluation.
	2.3.2	Employ evaluative tools (software/recordings) to check work.
	2.3.3	Understand steps to take to create improvement plan when needed.
	2.3.4	Communicate evaluation and feedback to customer.
Topic 2.4	**Perform configuration management activities.**	
	Student Competencies	
	2.4.1	Demonstrate knowledge of identification and control functions.
	2.4.2	Demonstrate knowledge of version management and interface control.
	2.4.3	Select appropriate tools for configuration management.
	2.4.4	Determine standards to be applied (e.g., international, industry, military).
	2.4.5	Specify baseline and software life-cycle phases.
	2.4.6	Assess the impact of changes that affect interfaces.

Topic 2.5	**Evaluate application software packages.**	
	Student Competencies	
	2.5.1	Perform workflow analysis to determine user needs.
	2.5.2	Evaluate appropriateness of software for specific projects.
	2.5.3	Prepare a cost-benefit analysis for a software package.
	2.5.4	Document results of the software evaluation.
	2.5.5	Perform a software configuration audit.
	2.5.6	Perform a physical configuration audit.
	2.5.7	Develop a method for evaluation.
	2.5.8	Test the functionality of proposed software configuration.
Topic 2.6	**Identify the purpose of computer components (e.g. current and new technologies as they arrive).**	
	Student Competencies	
	2.6.1	Explain the purpose of computer components and how they work together as a system.
	2.6.2	Demonstrate knowledge of the CPU (e.g., Intel, AMD, etc.) and sockets.
	2.6.3	Demonstrate knowledge of Chipsets/BIOS and their drivers.
	2.6.4	Demonstrate knowledge of motherboard/CPU (e.g., North/Southbridge, L1/L2, multi-core, bus, 32/64 bit, form-factor, slots, etc.).
	2.6.5	Demonstrate knowledge of memory modules (e.g., DDR3, DDR4, etc.).
	2.6.6	Demonstrate knowledge of hard drive setup and troubleshooting.
	2.6.7	Demonstrate knowledge of hard drive technologies.
	2.6.8	Demonstrate knowledge of I/O ports.
	2.6.9	Demonstrate knowledge of NIC/wireless cards and troubleshooting their problems.
	2.6.10	Demonstrate knowledge of video cards, PCIe, and slots.
	2.6.11	Demonstrate knowledge of INPUT and OUTPUT devices (e.g., keyboard, mouse, touchpad, cameras, scanners, microphones, printers, barcode scanners, etc.).
	2.6.12	Demonstrate knowledge of portable devices and how they connect to and share data with computers.
	2.6.13	Demonstrate knowledge of power and power supplies and how associated problems can be solved.
	2.6.14	Demonstrate knowledge of peculiar features and problems of notebooks and other portable devices.
Topic 2.7	**Demonstrate knowledge to build or install computer system.**	
	Student Competencies	
	2.7.1	Demonstrate knowledge of how hardware components interact and how conflicts arise.
	2.7.2	Access needed information using manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts, device drivers).
	2.7.3	Secure supplies and resources.
	2.7.4	Demonstrate knowledge of error messages and symptoms of hardware failures.
	2.7.5	Install mainboard (with memory/CPU).
	2.7.6	Connect peripherals and expansion cards to/in mainboard.

	2.7.7	Demonstrate knowledge to install drives (e.g., SATA).
	2.7.8	Employ appropriate safety precautions for the worker and hardware when working with PC.
	2.7.9	Configure hardware system.
	2.7.10	Verify system operation.
	2.7.11	Check OS operations, updates and Service Packs.
	2.7.12	Document system installation activities.
	2.7.13	Backup system and configuration.
	2.7.14	Test all applications.
	2.7.15	Restore system and configuration.
	2.7.16	Transfer system settings and files from old system to new.
Topic 2.8	**Demonstrate ability to couple troubleshooting skills with hardware knowledge to solve client problems.**	
	Student Competencies	
	2.8.1	Know startup sequence.
	2.8.2	Identify priorities and interrupts at system level.
	2.8.3	Demonstrate ability to couple memory upgrades with motherboard (RAM chips, different types).
	2.8.4	Test system using diagnostic tools/software.
	2.8.5	Identify problems in the operating system and related hardware.
	2.8.6	Differentiate between hardware and software failure.
	2.8.7	Demonstrate hard drive maintenance procedures (e.g. scan, clear caches, etc.).
	2.8.8	Gather information on problem from user.
	2.8.9	Conduct appropriate diagnostic tests.
	2.8.10	Replace malfunctioning hardware.
	2.8.11	Reinstall software as needed.
	2.8.12	Demonstrate backup and recovery.
	2.8.13	Restore system to various states (safe modes, previous date, etc.).
Topic 2.9	**Demonstrate knowledge of Operating System components in the building and deployment of computer systems.**	
	Student Competencies	
	2.9.1	Identify differences between O/Ss (Windows/Linux/Mac).
	2.9.2	Demonstrate knowledge of components of O/S (explorer, Control panel, etc.).
	2.9.3	Demonstrate knowledge of startup sequence of O/Ss.
Topic 2.10	**Demonstrate knowledge of Operating System components in the repair and maintenance of computer systems.**	
	Student Competencies	
	2.10.1	Connect stations to each other and to Internet.
	2.10.2	Connect stations to peripheral devices, especially printers.
	2.10.3	Protect stations from viruses, malwares, adware, security breaches, etc.
	2.10.4	Test integrity and drivers of all devices recognized by O/S.
	2.10.5	Recover from system errors.

	2.10.6	Understand the importance of upgrading from one generation of O/S to the next.
	2.10.7	Install new hardware (drives, cards, etc.) on O/S.
Topic 2.11	**Describe basic network classifications, topologies and network operating systems (NOS).**	
	Student Competencies	
	2.11.1	Interpret basic networking terminology.
	2.11.2	Differentiate between LANs, MANs and WANs.
	2.11.3	Identify the basic point-to-point/broadcast network topologies (e.g., routers, switches, wireless technologies, star, tree, network, irregular).
Topic 2.12	**Demonstrate the use of networking concepts in the support and maintenance of the computers on the network.**	
	Student Competencies	
	2.12.1	Demonstrate knowledge of the characteristics and uses of network components (e.g., switches, routers, wireless routers, firewall).
	2.12.2	Differentiate between a physical and logical topology.
	2.12.3	Demonstrate knowledge of LAN transmission methods, standards, and protocols.
Topic 2.13	**Initiate a system project.**	
	Student Competencies	
	2.13.1	Identify the phases in a system project.
	2.13.2	Select basic fact-gathering techniques to be used.
	2.13.3	Define the scope of the systems project.
	2.13.4	Conduct a preliminary investigation.
Topic 2.14	**Evaluate applications within the information system.**	
	Student Competencies	
	2.14.1	Design a framework for evaluating information system functions.
	2.14.2	Design a framework for evaluating individual applications.
	2.14.3	Recommend new features or enhancements to existing tools.
	2.14.4	Research the concept of information system life cycles.
Topic 2.15	**Troubleshoot problems and evaluate problem-solving processes and outcomes.**	
	Student Competencies	
	2.15.1	Demonstrate knowledge of basic troubleshooting steps.
	2.15.2	Minimize impact of problems on productivity (e.g., minimize downtime).
	2.15.3	Evaluate problem-solving outcomes to determine whether the problem was solved as intended.
	2.15.4	Evaluate whether the process was applied in an efficient and responsible manner.
	2.15.5	Assess the validity and usefulness of the outcomes.
	2.15.6	Determine needed follow-up actions.
Topic 2.16	**Apply quality cost implications to a project.**	
	Student Competencies	
	2.16.1	Establish cost/quality objectives.

	2.16.2	Establish guidelines for liability prevention.
	2.16.3	Classify costs (e.g., direct and indirect, fixed and variable, methods and standards).
	2.16.4	Classify quality costs (e.g., prevention, evaluation, pre-delivery failure, post-delivery failure).
	2.16.5	Identify safety terms of product.
	2.16.6	Identify safety responsibility within organization.

Standard 3	*NETWORK SYSTEMS*	
Topic 3.1	**Conduct needs analysis.**	
	Student Competencies	
	3.1.1	Collect information on system objectives from users.
	3.1.2	Develop workflow analysis to determine user needs.
	3.1.3	Analyze existing procedures.
	3.1.4	Define business objectives to be achieved by the application.
	3.1.5	Determine necessary user applications (e.g., web access, email).
	3.1.6	Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, and work flowcharts).
Topic 3.2	**Develop networking requirements specifications.**	
	Student Competencies	
	3.2.1	Demonstrate knowledge of the use, structure, and contents of a requirements specification document.
	3.2.2	Define system and software requirements.
	3.2.3	Develop informal and formal specifications.
	3.2.4	Evaluate installation requirements.
	3.2.5	Solve conflicting requirements.
	3.2.6	Review and verify specifications with customer.
Topic 3.3	**Analyze requirements/specifications using current IT approaches.**	
	Student Competencies	
	3.3.1	Analyze facilities' bandwidth requirements.
	3.3.2	Demonstrate knowledge of how to use software methodologies to analyze a real-world problem.
	3.3.3	Identify site and system constraints.
	3.3.4	Identify security requirements.
	3.3.5	Identify time, technology, and resource constraints.
	3.3.6	Identify physical requirements for system implementation.
	3.3.7	Identify system requirements for various types of installations.
	3.3.8	Identify new application requirements within the system.
	3.3.9	Identify environment requirements, conditions, and limitations.
	3.3.10	Determine required service level.
	3.3.11	Identify input and output requirements.
	3.3.12	Identify hardware, networking, and software system functional requirements.
	3.3.13	Demonstrate knowledge of nonfunctional requirements (e.g., integrity response time, reliability, support, and documentation).

Topic 3.4	**Analyze the computer site environment.**	
	Student Competencies	
	3.4.1	Identify power and power supplies.
	3.4.2	Define power conversion.
	3.4.3	Analyze facilities' capacity planning.
	3.4.4	Evaluate the potential effects of emerging technologies on information system software/hardware.
Topic 3.5	**Analyze network security systems.**	
	Student Competencies	
	3.5.1	Identify security requirements and the need for data protection.
	3.5.2	Identify specific access levels that need to be accommodated.
	3.5.3	Match security system design to identified security requirements.
	3.5.4	Develop security plan.
Topic 3.6	**Demonstrate knowledge of the basics of network architecture.**	
	Student Competencies	
	3.6.1	Demonstrate knowledge of the characteristics and uses of network components.
	3.6.2	Differentiate between a physical and logical topology.
	3.6.3	Demonstrate a basic knowledge of OSI modeling.
	3.6.4	Demonstrate knowledge of LAN transmission protocols, methods, and standards.
	3.6.5	Demonstrate knowledge of various frame types and formats.
	3.6.6	Differentiate processes, services, and protocols.
Topic 3.7	**Demonstrate knowledge of basic network classifications and topologies.**	
	Student Competencies	
	3.7.1	Differentiate between LANs and WANs.
	3.7.2	Differentiate between point-to-point and point-to-multipoint network topologies.
	3.7.3	Demonstrate knowledge of packet-switching techniques.
	3.7.4	Identify basic physical and logical topologies.
	3.7.5	Demonstrate knowledge of characteristics of connection-oriented and connectionless networks.
	3.7.6	Identify emerging networks.
	3.7.7	Investigate emerging technologies.
	3.7.8	Demonstrate knowledge of electronic communications.
	3.7.9	Demonstrate knowledge of Voice over IP (VoIP) concepts.
	3.7.10	Explain convergence issues, including codec choice, jitter, wander, and connecting analog telephone adapter equipment.
	3.7.11	Describe common VoIP protocols, including Session Initiation Protocol (SIP), H.323, and Megaco/H.248.
	3.7.12	Explain the benefits of implementing convergence.

Topic 3.8	**Implement common network computing platforms.**	
	Student Competencies	
	3.8.1	Identify how the four components of a network operating system support network operations.
	3.8.2	Select a LAN/WAN technology that meets defined set of requirements.
	3.8.3	Demonstrate knowledge of the reasons for installing a network.
	3.8.4	Demonstrate knowledge of local-area network (LAN) trends and issues.
	3.8.5	Analyze current trends and development in LANs.
Topic 3.9	**Characterize network connectivity basis, transmission line applications, and communication standards for networks.**	
	Student Competencies	
	3.9.1	Demonstrate knowledge of the principles and operation of wired and wireless systems.
	3.9.2	Demonstrate knowledge of the principles and operation of analog and digital circuits.
	3.9.3	Demonstrate knowledge of the open system interconnection (OSI) standard.
	3.9.4	Identify standard high-speed networks.
	3.9.5	Demonstrate knowledge of the TCP/IP protocol suite.
Topic 3.10	**Use WAN systems in network development.**	
	Student Competencies	
	3.10.1	Relate voice, data concepts, and video to delivery of video services.
	3.10.2	Select primary and backup data circuits.
	3.10.3	Evaluate analog and digital transmission for cost, performance, and reliability.
	3.10.4	Demonstrate knowledge of firewall implementation between trusted network and WAN.
	3.10.5	Demonstrate knowledge of interconnecting LANs using WAN services.
Topic 3.11	**Implement network security systems.**	
	Student Competencies	
	3.11.1	Demonstrate knowledge of security requirements and the need for data protection.
	3.11.2	Demonstrate the knowledge of access levels that need to be accommodated.
	3.11.3	Implement security plan.
	3.11.4	Demonstrate knowledge of the role that routers, firewalls, intrusion detection systems, and VPNs play in security.
Topic 3.12	**Characterize the use of Network Operating Systems.**	
	Student Competencies	
	3.12.1	Demonstrate knowledge of the general characteristics of network operating systems.
	3.12.2	Demonstrate knowledge of network operating systems.
	3.12.3	Demonstrate knowledge about the difference between stand-alone, peer-to-peer, and client-server networks and software.
Topic 3.13	**Install a network infrastructure.**	
	Student Competencies	
	3.13.1	Evaluate installation requirements.
	3.13.2	Install appropriate operating system hardware and software and peripherals.

	3.13.3	Identify differences between stand-alone and network applications/operating systems.
	3.13.4	Access needed technical information using software help facilities.
	3.13.5	Install structured cabling.
	3.13.6	Ensure that all multi-user aspects of the application function are operational.
Topic 3.14	**Configure and install a network operating system.**	
	Student Competencies	
	3.14.1	Demonstrate knowledge of network operating system to configure.
	3.14.2	Load software with minimum disruption of process flow.
	3.14.3	Resolve compatibility issues.
	3.14.4	Configure software appropriately for system and user application.
	3.14.5	Add capability to a software system by recording macros and storing them in the system's library.
	3.14.6	Customize a general-purpose software package (e.g., DBMS) to provide specific functionality beyond the default setting.
	3.14.7	Assemble necessary components to complement information system design.
	3.14.8	Install LAN Management software.
Topic 3.15	**Monitor network performance including information management and infrastructure.**	
	Student Competencies	
	3.15.1	Monitor system status and performance.
	3.15.2	Conduct post-implementation evaluation.
	3.15.3	Identify abnormal system performance.
	3.15.4	Create a baseline of system/network performance.
	3.15.5	Identify required service level.
	3.15.6	Identify system alerts.
	3.15.7	Identify security problems.
	3.15.8	Identify environmental problems.
	3.15.9	Perform remote monitoring.
Topic 3.16	**Demonstrate knowledge of disaster recovery and business continuance.**	
	Student Competencies	
	3.16.1	Differentiate between disaster recovery and business continuance.
	3.16.2	Identify the steps in a disaster recovery plan and a business resumption plan.
	3.16.3	Identify methods for avoiding common computer system disasters.
	3.16.4	Identify common backup devices.
	3.16.5	Identify the criteria for selecting a backup system.
	3.16.6	Compare/contrast streaming file-by-file backup systems.
	3.16.7	Establish process for archiving files.
	3.16.8	Develop a disaster recovery plan.
	3.16.9	Develop a business resumption plan.

	3.16.10	Conduct backup of system.
	3.16.11	Conduct system restore.
Topic 3.17	**Perform network system administration tasks.**	
	Student Competencies	
	3.17.1	Identify principles governing software acquisition and upgrades.
	3.17.2	Manage inventory and assets.
	3.17.3	Retrieve/analyze historical data for trends analysis.
	3.17.4	Perform administration functions using LAN manager software.
	3.17.5	Respond appropriately to system messages.
	3.17.6	Choose and implement an appropriate routing protocol.
	3.17.7	Develop a logical device naming convention.
	3.17.8	Define traffic priorities.
Topic 3.18	**Perform network system maintenance.**	
	Student Competencies	
	3.18.1	Demonstrate knowledge of the basic elements of network maintenance.
	3.18.2	Identify available diagnostic tools used for system maintenance.
	3.18.3	Identify maintenance procedures and processes.
	3.18.4	Identify problems using diagnostic tools.
	3.18.5	Respond to system messages.
	3.18.6	Document network system malfunction(s).
	3.18.7	Fix recoverable problems.
	3.18.8	Perform preventive maintenance procedures on computer and peripheral devices.
	3.18.9	Identify new or replacement networking components needed.
	3.18.10	Establish a preventive maintenance plan.
	3.18.11	Create maintenance plan for regular integrity checks.

Standard 4	***PROGRAMMING AND SOFTWARE DEVELOPMENT***	
Topic 4.1	**Gather data to identify customer requirements.**	
	Student Competencies	
	4.1.1	Demonstrate knowledge of nonfunctional requirements (e.g., security, integrity response time, reliability, support, and documentation).
	4.1.2	Identify input and output requirements.
	4.1.3	Identify system processing requirements.
	4.1.4	Identify hardware, networking, and software system functional requirements.
	4.1.5	Access needed information using company and manufacturers' references.
Topic 4.2	**Define scope of work for the programming project.**	
	Student Competencies	
	4.2.1	Demonstrate knowledge of how to use software methodologies to analyze a real-world problem.
	4.2.2	Demonstrate knowledge of the key functions and subsystems of the software product.
	4.2.3	Demonstrate knowledge of software development process and issues.
	4.2.4	Demonstrate knowledge of the system life-cycle approach.
Topic 4.3	**Design and execute software project plan.**	
	Student Competencies	
	4.3.1	Demonstrate knowledge of software development methodology.
	4.3.2	Identify system processing requirements.
	4.3.3	Identify data communication trends and major current issues.
	4.3.4	Identify new and emerging classes of software and IT technologies.
	4.3.5	Determine compatibility of hardware and software.
Topic 4.4	**Explain measurement techniques for increased productivity due to information systems implementation.**	
	Student Competencies	
	4.4.1	Identify metrics for measurements.
	4.4.2	Measure increases in productivity realized by the implementation of information systems.
Topic 4.5	**Employ tools in developing software applications.**	
	Student Competencies	
	4.5.1	Demonstrate knowledge of software development environment.
	4.5.2	Use prototyping techniques.
	4.5.3	Use appropriate configuration management tools.
	4.5.4	Use appropriate issues tracking tools.
	4.5.5	Demonstrate knowledge of reuse and components.

Topic 4.6	**Demonstrate use of computer-aided software engineering (CASE) tools.**	
	Student Competencies	
	4.6.1	Use appropriate requirement analysis tools.
	4.6.2	Use appropriate modeling and analysis tools.
	4.6.3	Use requirement tracking tools.
	4.6.4	Demonstrate knowledge of software reuse, design pattern, and components.
Topic 4.7	**Apply language-specific programming tools/techniques.**	
	Student Competencies	
	4.7.1	Develop programs using appropriate language.
	4.7.2	Use appropriate development environment for the selected language.
	4.7.3	Use user interface development tools.
Topic 4.8	**Describe software development processes and methodology.**	
	Student Competencies	
	4.8.1	Identify the use of program design tools in a software development process.
	4.8.2	Identify roles of team members/customers in the software development process.
	4.8.3	Identify current information life cycle models.
	4.8.4	Create design specifications for a computer application.
	4.8.5	Describe trade-offs involved in design choices.
	4.8.6	Summarize the use of the principles of effective information management, information organization, and information-retrieval skills when designing a software application.
	4.8.7	Demonstrate knowledge of the information system life cycle.
	4.8.8	Demonstrate knowledge of system analysis issues related to design, testing, implementation, and maintenance.
Topic 4.9	**Explain programming language concepts.**	
	Student Competencies	
	4.9.1	Demonstrate knowledge of the hardware-software connections.
	4.9.2	Demonstrate knowledge of the concepts of data and procedural representations.
	4.9.3	Demonstrate knowledge of the basic principles for analyzing a programming language.
	4.9.4	Demonstrate knowledge of the basics of structured, object-oriented language.
	4.9.5	Demonstrate knowledge of how a programming language can support multitasking and exception-handling.
Topic 4.10	**Summarize program development methodology.**	
	Student Competencies	
	4.10.1	Demonstrate knowledge of how to resolve program implementation issues.
	4.10.2	Demonstrate knowledge of software development issues.
	4.10.3	Demonstrate knowledge of code analysis issues related to design, testing, implementation, and maintenance.
	4.10.4	Demonstrate knowledge of how to design and implement programs in a top-down manner.
	4.10.5	Demonstrate knowledge of how to translate algorithmic and modular designs to develop a program.
	4.10.6	Demonstrate knowledge of structured/modular programming.

	4.10.7	Demonstrate knowledge of how programming control structures are used to verify correctness.
	4.10.8	Use code development tools (e.g. debugger, integrated development environments).
Topic 4.11	**Demonstrate proficiency in developing an application using an appropriate programming language.**	
	Student Competencies	
	4.11.1	Describe the range of languages used in software development.
	4.11.2	Demonstrate knowledge of current key programming languages and the environment in which they are used.
	4.11.3	Translate data structure and program design into code in an appropriate language.
	4.11.4	Demonstrate knowledge of key constructs and commands specific to a language.
Topic 4.12	**Explain basic software systems implementation.**	
	Student Competencies	
	4.12.1	Use appropriate programming language.
	4.12.2	Compile and/or debug code.
	4.12.3	Prepare code documentation.
	4.12.4	Conduct unit testing and bug fixes.
Topic 4.13	**Develop software requirements/specifications and integration.**	
	Student Competencies	
	4.13.1	Access needed information using company and manufacturers' references.
	4.13.2	Divide design specifications into logical process blocks and identify parameters.
	4.13.3	Follow specifications or drawings.
	4.13.4	Record the programming process utilizing flowcharts and/or step-by-step documentation.
	4.13.5	Identify unexpected results.
	4.13.6	Review and revise code.
Topic 4.14	**Develop a software test plan.**	
	Student Competencies	
	4.14.1	Access needed information using appropriate reference materials.
	4.14.2	Define test procedures.
	4.14.3	Analyze requirement and design specifications.
	4.14.4	Development test cases using requirements and design specification.
Topic 4.15	**Perform testing and validation.**	
	Student Competencies	
	4.15.1	Perform integration testing.
	4.15.2	Perform regression testing.
	4.15.3	Help with user-acceptance test.
	4.15.4	Validate user documentation.
	4.15.5	Document test results.
	4.15.6	Document errors discovered.
	4.15.7	Perform defect tracking.

Topic 4.16	**Summarize software quality assurance (QA) procedures.**	
	Student Competencies	
	4.16.1	Demonstrate knowledge of Software QA process.
	4.16.2	Demonstrate knowledge of the standards/requirements for Software QA.
	4.16.3	Develop team relationships to support Software QA tasks.
	4.16.4	Identify standards and issues related to I/O programming and design of I/O interfaces.
	4.16.5	Recognize the relationship between dependability, functionality, ease of use, etc.
	4.16.6	Conduct code walkthrough and/or inspection.
	4.16.7	Follow established procedures for testing, identifying problems, and tracking resolutions.
Topic 4.17	**Analyze software technical support needs.**	
	Student Competencies	
	4.17.1	Identify maintenance and support requirements.
	4.17.2	Apply information and data analysis techniques.
	4.17.3	Implement solutions in code and documentation.
	4.17.4	Release software and documentation updates according to procedures.
Topic 4.18	**Explain database development processes.**	
	Student Competencies	
	4.18.1	Identify appropriate database type based on customer requirements, availability of software and hardware resources, and distribution specifications, etc.
	4.18.2	Apply information and data analysis specifications to create a database model using techniques such as Entity Relationship Diagramming.
	4.18.3	Analyze and normalize the developed database model looking for and resolving potential problems.
	4.18.4	Analyze the security needs for the database.
Topic 4.19	**Create, populate, and maintain a database.**	
	Student Competencies	
	4.19.1	Create a database from model specifications using both program code and Graphic User Interface (GUI) processes when provided by the database software.
	4.19.2	Perform database queries to analyze database functionality and diagnose problems.
	4.19.3	Perform database troubleshooting and system-tuning functions.
	4.19.4	Communicate and document technical support provided.
	4.19.5	Release software and documentation updates according to procedures.
Topic 4.20	**Perform database interfacing with web applications.**	
	Student Competencies	
	4.20.1	Develop scripts and forms that permit access via websites to the database.
	4.20.2	Identify and analyze potential security problems for web access to the database.
	4.20.3	Propose security solutions to web-based security problems.
	4.20.4	Implement solutions in code and documentation.

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Standard 5	*WEB AND DIGITAL COMMUNICATIONS*	
Topic 5.1	**Collect requirements data from customers and competing web sites.**	
	Student Competencies	
	5.1.1	Determine purpose of the digital communication project.
	5.1.2	Determine the digital communication elements to be used.
	5.1.3	Determine clients' privacy policy and expectations.
	5.1.4	Apply for approval of a web site plan.
	5.1.5	Communicate technical concepts from web design to non-technical audiences.
Topic 5.2	**Analyze usability and accessibility as it pertains to customer needs.**	
	Student Competencies	
	5.2.1	Demonstrate knowledge of WAI priorities.
	5.2.2	Demonstrate knowledge of web metrics and governance (policies and stylebooks).
	5.2.3	Demonstrate knowledge of cultural implications on design and deployment of digital communication products.
	5.2.4	Engage in user testing throughout the design and development process.
Topic 5.3	**Prepare functional specifications.**	
	Student Competencies	
	5.3.1	Develop flowchart/navigational blueprints.
	5.3.2	Develop storyboards.
	5.3.3	Determine delivery platform(s).
	5.3.4	Design system architecture.
	5.3.5	Design user interface.
	5.3.6	Design navigational schema.
Topic 5.4	**Prepare visual design specifications.**	
	Student Competencies	
	5.4.1	Apply principles of design (color theory and schemes, proximity, alignment, repetition, web graphics, optimization, typography).
	5.4.2	Identify technical constraints.
	5.4.3	Create sample design showing placement of buttons/navigational graphics and suggested color scheme.
	5.4.4	Identify available media and content sources.
	5.4.5	Develop preliminary project budget.
Topic 5.5	**Select and use appropriate software tools.**	
	Student Competencies	
	5.5.1	Demonstrate proficiency in the use of digital imaging, digital video techniques, and equipment.
	5.5.2	Demonstrate knowledge of available graphics, video, motion graphics, web software programs.

	5.5.3	Demonstrate knowledge of available project management and collaborative tools.
	5.5.4	Demonstrate knowledge of integrated development environments (such as Visual Studio, Dreamweaver, Waterproof, etc.).
	5.5.5	Manipulate images, video, and motion graphics.
	5.5.6	Demonstrate knowledge of the basic principles of motion graphics.
	5.5.7	Identify how different user agents (browsers, devices) affect the digital communication product.
Topic 5.6	**Create product visual design.**	
	Student Competencies	
	5.6.1	Apply principles and elements of design.
	5.6.2	Apply color theory to select appropriate colors.
	5.6.3	Create and/or implement the look and feel of the product.
	5.6.4	Create graphical images and/or video elements.
	5.6.5	Apply knowledge of typography.
	5.6.6	Enhance digital communication presentation using a photographic process.
	5.6.7	Alter digitized images using an image manipulation program.
	5.6.8	Alter digitized video using a video manipulation program.
Topic 5.7	**Employ basic motion graphic programming knowledge.**	
	Student Competencies	
	5.7.1	Demonstrate knowledge of key frames and frames.
	5.7.2	Demonstrate knowledge of the impact that deployment device has on design and production needs.
	5.7.3	Demonstrate knowledge of animation techniques.
	5.7.4	Demonstrate knowledge of motion graphic security.
	5.7.5	Demonstrate that motion graphic meets the validation process and is compatible across multiple browsers or devices.
Topic 5.8	**Use basic web development skills.**	
	Student Competencies	
	5.8.1	Demonstrate knowledge of HTML, XHTML, and CSS.
	5.8.2	Demonstrate knowledge of version control and documentation.
	5.8.3	Demonstrate knowledge of basic web application security.
	5.8.4	Demonstrate that website meets the validation process and is compatible across multiple browsers and devices.
	5.8.5	Explain importance of web standards.
Topic 5.9	**Summarize Internet architecture elements.**	
	Student Competencies	
	5.9.1	Demonstrate knowledge of transfer protocols (FTP, WebDav).
	5.9.2	Demonstrate knowledge of Internet standards bodies.
	5.9.3	Identify cross-platform issues.

	5.9.4	Keep up-to-date with new and emerging trends related to the internet.
	5.9.5	Demonstrate knowledge of Web 3.0.
Topic 5.10	**Employ basic web programming knowledge.**	
	Student Competencies	
	5.10.1	Demonstrate knowledge of the purpose of web content delivery enablers (e.g., CGI, API, SSI).
	5.10.2	Demonstrate knowledge of how to interface client/server.
	5.10.3	Demonstrate knowledge of client-side processing and its advantages/disadvantages.
	5.10.4	Identify security issues related to server-side processing.
	5.10.5	Identify standard scripting languages (e.g., JavaScript, .NET frameworks, PHP, ActiveX,).
	5.10.6	Demonstrate knowledge of XML/XSL.
	5.10.7	Demonstrate knowledge of quality assurance.
	5.10.8	Demonstrate knowledge of the uses and advantages/disadvantages of various scripting languages.
	5.10.9	Demonstrate knowledge of how to use a scripting language to program a site.
Topic 5.11	**Employ web administration skills to maintain a web application.**	
	Student Competencies	
	5.11.1	Demonstrate knowledge of how to use advanced communication protocols.
	5.11.2	Compare the advantages and disadvantages of running your own server vs. using a server provider.
	5.11.3	Identify hardware requirements for a server.
	5.11.4	Identify server software options.
	5.11.5	Evaluate server providers.
	5.11.6	Establish a domain name.
	5.11.7	Comply with TCP/IP (Transfer Control Protocol/Internet Protocol).
	5.11.8	Upload files to the server.
	5.11.9	Publicize the site (e.g., submit announcements to major search engines).
	5.11.10	Explain the importance of ethical behaviors and legal issues.
	5.11.11	Collect/analyze usage statistics.
	5.11.12	Utilize back-up and restore software features.
	5.11.13	Document server environment to include specifications, passwords, and software versions.
Topic 5.12	**Produce a digital communication product.**	
	Student Competencies	
	5.12.1	Develop a conceptual model for the digital communication project.
	5.12.2	Select the media elements (e.g., sound, video, graphics, text, motion graphics) to be used.
	5.12.3	Integrate media elements.
	5.12.4	Select the publication process to be used.
	5.12.5	Select the distribution method to be used.
	5.12.6	Explain the impact that publication processes and distribution methods have on product development.

Topic 5.13	**Acquire and produce content for a digital communication product.**	
	Student Competencies	
	5.13.1	Produce or acquire graphics content.
	5.13.2	Produce or acquire motion graphics content.
	5.13.3	Produce or acquire audio content.
	5.13.4	Produce or acquire video content.
Topic 5.14	**Employ basic motion graphic programming knowledge.**	
	Student Competencies	
	5.14.1	Integrate the use of photographic special effects into interactive media presentations.
	5.14.2	Integrate photographically derived images with hand-drawn graphic images.
Topic 5.15	**Describe search engine management (SEM) and search engine optimization (SEO).**	
	Student Competencies	
	5.15.1	Measure current traffic on site.
	5.15.2	Determine and measure traffic sources.
	5.15.3	Determine that search engines can easily index web pages.
	5.15.4	Ensure code is W3C-compliant.
	5.15.5	Develop and implement a legal statement, privacy statement, and site map.
Topic 5.16	**Integrate media elements.**	
	Student Competencies	
	5.16.1	Determine needed media elements for site.
	5.16.2	Implement appropriate media elements for site.
Topic 5.17	**Explain the concept of intellectual property.**	
	Student Competencies	
	5.17.1	Identify and discuss appropriate state intellectual property laws.
	5.17.2	Identify and discuss national intellectual property laws.
	5.17.3	Identify any intellectual property issues in created web pages.
Topic 5.18	**Differentiate between copyright and trademarks.**	
	Student Competencies	
	5.18.1	Discuss the difference between copyright and trademarks.
	5.18.2	Discuss any copyright issues in web page being designed and how they will be managed.
	5.18.3	Discuss any trademark issues in web page being designed and how they will be managed.
Topic 5.19	**Describe the function of a non-disclosure agreement (NDA).**	
	Student Competencies	
	5.19.1	Discuss what a non-disclosure agreement (NDA) is.
	5.19.2	Identify who will be included in the NDA for the developed web page(s).
	5.19.3	Identify and discuss what will be included in the NDA.
	5.19.4	Determine the length of time the agreement will be in effect.

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Career Ready Practices

1. Lead as a Contributing & Professional Employee

Career-ready individuals understand the role and responsibilities of their position and demonstrate this understanding by regularly contributing to the success of their organization. They are reliable and lead by example through work ethic and professionalism, as defined by the standards set by their workplace. This Career Ready Practice includes understanding and exhibiting the core values of their organization and modeling strong morals, motivation, excellence, and consistency.

2. Communicate Clearly, Effectively, & with Reason

Career-ready individuals are able to communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. This Career Ready Practice includes actively listening to peers and colleagues regardless of level and ensuring that diverse perspectives are heard, considered, and fostered. Regardless of communication method, individuals understand the needs of a specific audience and are able to tailor their message or style to meet these needs. Proficiency in communication helps build strong relationships, facilitates collaboration, and ensures that information is accurately exchanged.

3. Think Critically to Make Sense of Problems & Persevere in Solving Them

Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and effectively plan to solve the problem in an efficient way. Individuals can analyze information and evaluate various courses of action for future success. This Career Ready Practice prepares individuals to tackle complex challenges, innovate solutions, and contribute to strategic planning and operational efficiency. Individuals should also use lessons learned from previous projects to improve future projects, systems, or processes through continuous improvement.

4. Collaborate Productively while Using Cultural & Global Competencies

Career-ready individuals are able to work effectively in diverse teams to successfully accomplish a goal in both in-person and virtual environments. This Career Ready Practice includes understanding team dynamics, respecting diverse perspectives, demonstrating empathy, and contributing positively to team outcomes. Effective collaboration leverages the strengths of team members, enhances problem-solving, and leads to innovative solutions by recognizing that each team member has something unique to contribute. Preparing to work in diverse teams ensures readiness for the collaborative nature of modern workplaces and requires recognizing biases and advocating for inclusive practices. Cultivating an inclusive environment not only enhances team dynamics but also drives innovation and reflects positively on organizational culture.

5. Use digital Skills & Technologies to Enhance Productivity & Make Data-informed Decisions

Career-ready individuals are digitally literate—proficient with the digital skills and technology that are regularly used in their evolving workplace. This Career Ready Practice involves using digital tools to enhance productivity, understanding the impact of technology on one's work, and staying updated with technological advancements that may have future impacts for a given industry area. Individuals can use technology and digital tools to analyze and report data, helping to make decisions that are data informed and data driven. Digitally literate individuals are also able to understand digital security and privacy and are able to use social media professionally and responsibly.

6. Remain Resilient in a Changing Workplace & World of Work

Career-ready individuals have the ability to adjust to change and remain resilient in the face of challenges, both within a workplace and throughout their careers. This Career Ready Practice involves maintaining a positive attitude despite challenges and being open to new ideas and feedback. Individuals seek to act in ways that contribute to the betterment of themselves and their teams, families, community, and workplace. Developing adaptability, flexibility, and resilience helps individuals navigate career transitions, embrace new opportunities, and maintain productivity and well-being under pressure. This Career Ready Practice also includes attending to one's own mental well-being and developing an appropriate work-life balance to sustain productivity, reduce stress, and enhance overall quality of life, which directly affects professional performance and satisfaction.

7. Manage Time & Space Effectively

Career-ready individuals are able to effectively manage their time and use organizational skills to prioritize tasks and meet deadlines. This Career Ready Practice includes planning, delegating tasks effectively, and maintaining a well-organized workspace in both physical and virtual environments. Developing these skills leads to increased efficiency, better project outcomes, and a balanced workload.

8. Demonstrate a Creative & Innovative Mindset

Career-ready individuals are able to use innovation and creativity to think outside the box and develop new ideas and solutions. This Career Ready Practice encourages a mindset of continuous improvement and adaptability and fosters a spirit of curiosity, experimentation, and calculated risk-taking. It prepares individuals to improve systems, drive change, create value, and stay competitive in a rapidly evolving workplace.

9. Act as a Good Steward of Organizational & Personal Finances & Resources

Career-ready individuals are financially literate and can demonstrate their ability to make cost effective decisions on behalf of themselves and their workplace. This Career Ready Practice includes managing personal finances, understanding financial documents, and making informed financial decisions. Financial literacy empowers individuals to make sound investments, budget effectively, and contribute to the financial health of their organization.

10. Navigate an Education & Career Path Aligned to Strengths, Work Style, Interests, & Goals

Career-ready individuals are self-aware about their strengths and working style and can understand how to leverage these traits effectively to maximize their careers. They are also aware of their areas for improvement, seeking opportunities for growth and acting on feedback to continuously improve. This Career Ready Practice is essential for setting realistic career goals, pursuing professional development opportunities, reskilling and upskilling to keep skills and knowledge relevant, and achieving personal and professional fulfillment.

11. Consider the Environmental & Social Impacts of Decisions

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively affect and/or mitigate negative impact on other people, their communities, and the environment. They make decisions with integrity by considering the moral and ethical consequences of their decisions and actively planning for the long-term success of projects, systems, and processes. Developing sustainability and environmental literacy skills prepares individuals to also contribute to a greener future and address global challenges.

12. Apply appropriate academic & technical skills

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be effective and productive employees. They have the technical proficiency to use the language, tools, technologies, and methodologies that are relevant to their specific industry sector. They make connections between abstract concepts and real-world applications, and they make correct determinations about when applying an academic skill is appropriate in a workplace situation. This Career Ready Practice includes staying updated about industry advancements and continuously improving technical skills aligned with the changing needs of their sector.