

Career & Technical Education | Information Technology

Network Management

Subject Code: 145045

Outcome & Competency Descriptions

Course Description:

Students will perform network administrator duties by installing and configuring network hardware, software, and peripherals. Abiding by IEEE standards and the Open-Source Interconnection (OSI) model, students will create advanced networks, assign user rights, and develop knowledge and skills of network hierarchy. Students will demonstrate mastery of topologies, remote connectivity, wireless networking and TCP/IP.

Strand 1. Business Operations/21st Century Skills

Learners apply principles of economics, business management, marketing, and employability in an entrepreneur, manager, and employee role to the leadership, planning, developing, and analyzing of business enterprises related to the career field.

Outcome: 1.1. Employability Skills

Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

Competencies

- 1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

Outcome: 1.2. Leadership and Communications

Process, maintain, evaluate, and disseminate information in a business.
Develop leadership and team building to promote collaboration.

Competencies

- 1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.

Outcome: 1.3. Business Ethics and Law

Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

Competencies

- 1.3.1. Analyze how regulatory compliance affects business operations and organizational performance.
- 1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.
- 1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

Outcome: 1.4. Knowledge Management and Information Technology

Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

Competencies

- 1.4.2. Select and use software applications to locate, record, analyze and present information (e.g., word processing, e-mail, spreadsheet, databases, presentation, Internet search engines).
- 1.4.3. Verify compliance with security rules, regulations and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to the industry pathway.
- 1.4.5. Use information technology tools to maintain, secure and monitor business records.
- 1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books).

Outcome: 1.8. Operations Management

Plan, organize and monitor an organization or department to maximize contribution to organizational goals and objectives.

Competencies

- 1.8.1. Forecast future resources and budgetary needs using financial documents (e.g., balance sheet demand forecasting, financial ratios).
- 1.8.4. Identify alternative actions to take when goals are not met (e.g., changing goals, changing strategies, efficiencies).
- 1.8.5. Use inventory and control systems to purchase materials, supplies and equipment (e.g., Last In, First Out [LIFO]; First In, First Out [FIFO]; Just in Time [JIT]; LEAN).
- 1.8.6. Identify the advantages and disadvantages of carrying cost and Just-in-Time (JIT) production systems and the effects of maintaining inventory (e.g., perishable, shrinkage, insurance) on profitability.
- 1.8.7. Collect information and feedback to help assess the organization's strategic planning and policymaking processes.
- 1.8.8. Identify routine activities for maintaining business facilities and equipment.
- 1.8.9. Develop a budget that reflects the strategies and goals of the organization.
- 1.8.10. Analyze how business management and environmental management systems (e.g., health, safety) contribute to continuous improvement and sustainability.

Strand 2. IT Fundamentals

Learners apply fundamental principles of IT, including the history of IT and its impact on society, common industry terms, systems theory, information storage and retrieval, database management, and computer hardware, software, and peripheral device configuration and installation. This base of knowledge and skills may be applied across the career field.

Outcome: 2.2. Networking Fundamentals

Apply networking fundamentals to infrastructure systems.

Competencies

- 2.2.3. Select network storage techniques (e.g., fiber channel, cloud, Fiber Channel over Ethernet [FCoE], Serial Attached SCSI [SAS], Network File Systems [NFS], Network Attached Storage/Server Message Blocks [NAS/SMB], Redundant Array of Inexpensive Disks [RAID]).
- 2.2.5. Identify and apply Transmission Control Protocol and Internet Protocol (TCP/IP), Internet Protocol Version 4 (IPv4), Internet Protocol Version 6 (IPv6) applications and services (e.g., rlogin, Simple Mail Transfer Protocol [SMTP], Telecommunications Network [Telnet], File Transfer Protocol [FTP], Domain Name System [DNS], Network File System [NFS], Voice over Calibri Bold Internet Protocol [VoIP], Internet Control Message Protocol [ICMP]).
- 2.2.8. Describe the characteristics and uses of networks, network devices, and components (e.g., hubs, switches, routers, firewalls).

Outcome 2.5. Maintain Operating Systems

Install and maintain operating systems (OSs).

Competencies

- 2.5.5. Use system utilities to maintain an Operating System.

Outcome: 2.9. Project Concept Proposal

Develop a project concept proposal.

Competencies

- 2.9.2. Determine the scope and purpose of the project.
- 2.9.3. Determine the target audience, client needs, expected outcomes, objectives, and budget.
- 2.9.4. Develop a conceptual model and design brief for the project.
- 2.9.5. Develop a timeline, a communication plan, a task breakdown, costs (e.g., equipment, labor), deliverables, and responsibilities for completion.
- 2.9.6. Develop and present a comprehensive proposal to stakeholders.

Outcome: 2.10. Equipment

Select, prepare, operate, and maintain equipment.

Competencies

- 2.10.1. Identify hardware platforms, configurations, and support models.
- 2.10.2. Identify processor, memory, storage, power, and environmental requirements.
- 2.10.3. Identify architecture requirements.
- 2.10.4. Identify software application requirements.
- 2.10.5. Prepare and operate equipment per project design specifications.
- 2.10.6. Monitor equipment operation and troubleshoot issues and problems.
- 2.10.7. Backup, restore, test, archive, and manage data.
- 2.10.8. Prepare equipment for storage or decommissioning.
- 2.10.9. Perform routine maintenance per manufacturer specifications.

Outcome: 2.11. Troubleshooting

Select and apply troubleshooting methodologies for problem solving.

Competencies

- 2.11.1. Identify the problem.
- 2.11.2. Select troubleshooting methodology (e.g., top down, bottom up, follow the path, spot the differences).
- 2.11.3. Investigate symptoms based on the selected methodology.
- 2.11.4. Gather and analyze data about the problem.
- 2.11.5. Design a solution.
- 2.11.6. Test a solution.

- 2.11.7. Implement a solution.
- 2.11.8. Document the problem and the verified solution.

Outcome: 2.12. Performance Tests and Acceptance

Develop performance tests and acceptance plans.

Competencies

- 2.12.1. Create a written procedure agreed by the stakeholders and project team for determining the acceptability of the project deliverables.
- 2.12.2. Develop a test system that accurately mimics external interfaces.
- 2.12.3. Develop test cases that are realistic, compare with expected performance, and include targeted platforms and device types.
- 2.12.4. Develop, perform, and document usability and testing integration.
- 2.12.5. Make corrections indicated by test results.
- 2.12.6. Seek stakeholder acceptance upon successful completion of the test plan.

Outcome: 2.13. Rollout and Handoff

Plan rollout and facilitate handoff to customers.

Competencies

- 2.13.1. Include overall project goals and timelines in the rollout plan.
- 2.13.2. Communicate rollout plans to key stakeholders in a timely manner.
- 2.13.3. Conduct final review and approvals according to company standards.
- 2.13.4. Identify support staff, training needs, and contingency plans in the rollout plan.
- 2.13.5. Test delivered application to assure that it is fully functional for the customer or user and meets all requirements.
- 2.13.6. Deliver support and training materials.

Strand 3. Information Security

Learners apply principles of information security to implement and maintain security compliance and network security. Learners select components and mechanisms required for a multilayer defense structure and evaluate and minimize security risks to wired and wireless networks and devices.

Outcome: 3.2. General Security Compliance

Implement and maintain general security compliance.

Competencies


3.2.2. Perform backup, restore, and verification procedures.

Outcome: 3.4. Multilayer Defense Structure

Explain information technology mechanisms as they apply to a multilayer defense structure.

Competencies

- 3.4.1. Describe available systems for intrusion prevention, detection, and mitigation.
- 3.4.2. Analyze system log files to identify security events.
- 3.4.3. Compare and contrast network analysis software (e.g., network analyzer) and hardware tools to identify security risks and vulnerabilities.

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- 3.4.4. Identify the components of human security (e.g., social engineering) and techniques to mitigate human security threats (e.g., policies, procedures, training).

Strand 4. Infrastructure Systems

Learners apply principles of networking and infrastructure related to the installation, administration, and maintenance of computer networks and components. Knowledge and skills may be applied to network connectivity, cabling, protocols, architecture, classification, topologies, operating systems, Open Systems Interconnection (OSI) standards, data encoding, Quality of Service (QoS), Internet Protocol (IP) addressing, and wide area network (WAN) design.

Outcome: 4.5. Wireless Network Solutions

Design and implement wireless network solutions.

Competencies

- 4.5.1. Compare secure wireless solutions operating in ad-hoc, infrastructure, or mesh modes.
- 4.5.2. Describe the frequency ranges and associated rules in the wireless spectrum as managed by the Federal Communication Commission (FCC).
- 4.5.3. Describe the Service Set Identifier (SSID) as used in wireless communications.
- 4.5.4. Select and install access points, wireless Network Interface Cards (NICs), antennas, and other hardware and software components to provide a wireless networking solution as determined by a site and customer survey.
- 4.5.5. Troubleshoot Wireless Local Area Networks (WLANs) using system logs, vendor-provided utilities, and diagnostic tools.
- 4.5.6. Secure the wireless network.
- 4.5.7. Configure a wireless mesh network with non-overlapping channels.

Outcome: 4.6. Network Protocols

Compare network protocols.

Competencies

- 4.6.1. Explain network protocols (e.g., Transmission Control Protocol/Internet Protocol [TCP/IP], User Datagram Protocol [UDP], Internet Protocol Version 4 [IPv4], Internet Protocol Version 6 [IPv6]).
- 4.6.2. Identify the advantages of protocols (e.g., Domain Name System [DNS], File Transfer Protocol [FTP], Hypertext Transfer Protocol [HTTP], Telecommunications Network [Telnet], Remote Desktop Protocol [RDP], Secure Shell [SSH]) and associated port numbers.
- 4.6.5. Identify Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) conventional ports (e.g., Simple Mail Transfer Protocol [SMTP], Telnet, Hypertext Transfer Protocol [HTTP], File Transfer Protocol [FTP]).

Outcome: 4.7. Transmission Control Protocol/Internet Protocol (TCP/IP)

Describe IP addressing schemes and create subnet masks.

Competencies

- 4.7.1. Explain Fully Qualified Domain Names (FQDNs) and how they are used.
- 4.7.2. Explain the IP addressing scheme and how it is used.
- 4.7.3. Identify Class A, B, and C reserved (i.e., private) address ranges and why they are used.
- 4.7.4. Identify the class of network to which a given address belongs.
- 4.7.5. Differentiate between default subnet masks and custom subnet masks.
- 4.7.6. Explain the relationship between an IP address and its associated subnet mask.
- 4.7.7. Identify the differences between classful and classless addressing schemes.
- 4.7.8. Identify multicasting addresses and explain why they are used.
- 4.7.9. Create custom subnet masks to meet network design requirements.
- 4.7.10. Compare Internet Protocol Version 4 (IPv4) and Internet Protocol Version 6 (IPv6).

Outcome: 4.8. Network Operating Systems and Architecture

Describe and install networking operating systems and architecture.

Competencies

- 4.8.1. Describe media-access protocols (e.g., Carrier Sense Multiple Access with Collision Detection [CSMA/CD], Carrier Sense Multiple Access with Collision Avoidance [CSMA/CA]).
- 4.8.2. Identify the components and relationships within the Institute of Electrical and Electronics Engineers (IEEE) 802 standards.
- 4.8.3. Identify Local Area Network (LAN) performance factors (e.g., signal attenuation, signal propagation delay).
- 4.8.4. Explain the role of the Internet Engineering Task Force (IETF) in facilitating protocol development.
- 4.8.5. Implement and maintain Virtual Local Area Networks (VLANs).
- 4.8.6. Explain how the components of a network operating system (i.e., server platform, network services software, network redirection software, communications software) and all support network operations.
- 4.8.7. Identify licensing requirements.
- 4.8.8. Describe the characteristics of the tiered model (e.g., peer-to-peer, thin client, thick client, cloud).
- 4.8.9. Analyze the advantages and disadvantages of the client/server model.
- 4.8.10. Select network, desktop, and mobile Operating Systems.
- 4.8.11. Install, test, and patch network operating systems manually and using automation.

- 4.8.12. Log in to a network device (e.g., router, Secure File Transfer Protocol [SFTP] server, directory server).
- 4.8.13. Evaluate the performance of the network operating system.

Outcome: 4.9. Network Administration

Administer network operating systems and services.

Competencies

- 4.9.1. Select physical and logical topology.
- 4.9.2. Connect devices to network systems.
- 4.9.3. Create domain trusts.
- 4.9.4. Maintain domain controllers.
- 4.9.5. Create user accounts, groups, and login scripts.
- 4.9.6. Establish shared network resources.
- 4.9.7. Define and set access controls on files, folders, shares, and directories.
- 4.9.8. Configure network domain accounts and profiles.
- 4.9.9. Create roaming user profiles and use Group Policy Objects (GPO) to manage the user environment.
- 4.9.10. Troubleshoot network performance connectivity (e.g., performance monitor, command line utilities).
- 4.9.11. Explain the fundamentals of Quality of Service (QoS).
- 4.9.12. Securely delegate standard management tasks.
- 4.9.13. Establish a secure remote connection to manage network resources.

Outcome: 4.10. Cloud Computing

Implement a hypervisor.

Competencies

- 4.10.1. Differentiate between public, private, community and hybrid clouds and describe the fundamental cloud components (e.g., shared or dedicated processing, storage, memory, networking, hypervisor).
- 4.10.2. Provision cloud services (e.g., Software as a Service [SaaS], Platform as a Service [PaaS], Infrastructure as a Service [IaaS], Security as a Service [SECaaS], and Everything as a Service [XaaS]).

Outcome: 4.11. Wide Area Network

Design a wide area network (WAN).

Competencies

- 4.11.1. Select WAN connections (e.g., satellite, Synchronous Optical Network [SONET], T1, T3, E1, E3, Digital Subscriber Line [DSL], cable [DOCSIS], Worldwide Interoperability for Microwave Access [WiMAX], Multiprotocol Label Switching [MPLS], frame relay).
- 4.11.2. Describe point-to-point (PTP) and point-to-multipoint (PTMP) interconnection.
- 4.11.3. Evaluate and select basic telecommunications services (e.g., satellite, circuit switching, wireless, packet switching) and carriers for WAN requirements.
- 4.11.4. Identify advantages to a software defined WAN (SD-WAN).
- 4.11.5. Determine availability from Local Area Network (LAN) to meet WAN requirements.
- 4.11.6. Determine the speed needed between sites to access applications.
- 4.11.7. Determine the subnets needed on the WAN (e.g., Variable Length Subnet Masking [VLSM]).
- 4.11.8. Evaluate and select transmission options.
- 4.11.9. Evaluate and select routing protocols (e.g., Border Gateway Routing Protocol [BGRP], Open Shortest Path First [OSPF], Routing Information Protocol Version 2 [RIPv2]).
- 4.11.10. Implement and maintain routing tables (e.g., static, default and dynamic routes).
- 4.11.11. Implement and maintain Network Address Translation (NAT) and Port Address Translation (PAT).

Outcome: 4.12. Disaster Recovery

Recommend disaster recovery and business continuity plans.

Competencies

- 4.12.1. Differentiate between disaster recovery and business continuity.
- 4.12.2. Identify common local and cloud-based backup options.
- 4.12.3. Identify the criteria for selecting a backup system.
- 4.12.4. Establish a process for archiving files.
- 4.12.5. Develop and simulate a disaster recovery plan.

Outcome: 4.13. Internet of Things

Install, configure, and operate IoT devices.

Competencies

- 4.13.1. Compare IoT wireless standards (e.g. Z-Wave, Zigbee).
- 4.13.2. Compare smart home ecosystems (e.g. Apple Homekit, Google Home, Amazon Alexa, Matter).
- 4.13.3. Configure, secure and connect IoT devices to the network.
- 4.13.4. Create IoT automations.
- 4.13.5. Explain fog computing in the IoT environment.

Strand 9. Cybersecurity

Learners apply principles of Cybersecurity to secure and defend information technology systems, selection and implementation of methods and tools to secure physical and digital assets, manage threats, deploy countermeasures, and establish strategies to protect business information using risk and incident management.

Outcome: 9.2. Access Control and Asset Security

Apply identification (ID), authorization, and physical asset security.

Competencies

- 9.2.1. Perform authorization control (e.g., least privilege, separation of duties, mandatory access, discretionary access, rule-based access control, role-based access control, time of day restrictions, location distractions).
- 9.2.2. Implement authentication techniques (e.g., Tokens, Common access card, Smart card, Multifactor authentication, Single sign-on, Biometrics, Personal identification verification card, Username, Federation, Transitive trust/authentication).
- 9.2.3. Use authentication factors (e.g., something you are, something you have, something you know).