IT SKILL STANDARDS 2020 AND BEYOND

"Data Management and Engineering"

Job Cluster

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Data Management and Engineering

The definition for Data Management and Engineering as developed by approximately 100 Thought Leaders (mostly Chief Technology Officers and Chief Information Officers) through three meetings and follow-up surveys to gain consensus is:

> Database Management and Engineering typically utilizes specialized software to store, organize and secure data in both relational databases and in other non-relational formats. It includes capacity planning, installation, configuration, database design, migration, performance monitoring, security, and troubleshooting, as well as backup and data recovery. This definition was adapted from Wikipedia.

This packet includes…

Job skills as developed by subject matter experts (SMEs) via multiple synchronous meetings (Page 3).

The tasks, knowledge, skills and abilities (KSAs) were developed with a focus 12 to 36 months in the future for an entry-level employee working in that specific cluster.

More specific definitions can be found within the KSA list.

The average was calculated from the subject matter expert votes.

- A vote of "4" indicated the item must be covered in the curriculum.
- A vote of "3" indicated the item should be covered in the curriculum.
- A vote of "2" indicated that it would be nice for the item to be covered in the curriculum.
- A vote of "1" indicated the item should not be covered in the curriculum.

Employability Skills as developed by SMEs via multiple synchronous meetings (Page 6).

Employability competencies are essential for every IT job and are based on what the work requires. SMEs were offered three clearly-defined “levels of proficiency” for each employability skill. The proficiency scale is defined as Level 1 – basic; Level 2- intermediate; and Level 3 - advanced. The levels are cumulative, so a “Level 3” assumes the employee can perform all characteristics of “Level 1” and “Level 2.”

For each employability skill, SMEs selected the competency levels that best aligned with what would be expected from an entry-level worker for the job cluster in question.

Key Performance Indicators (KPIs) as developed by SMEs (Page 7).

Key Performance Indicators answer the question, “How do we know when a task is performed well?”

A search was performed to locate validated/verified KPIs for technician level work in IT fields. Sources included the Texas Skill Standards System, National Skill Standards Board, National Institute of Standards and Technology and other sources. The identified KPIs were then cross-referenced to the tasks for the ITSS 2020 job clusters. They were reviewed and revised by a group of the same subject matter experts who developed the tasks and KSAs for the cluster in a structured, facilitated verification session.

Student Learning Outcomes (SLOs) as identified by educators attending the KSA meetings (Page 9).

The SLOs are for use in the creation of curriculum to help define what the students will know and be able to demonstrate. Each of these SLOs can be observed, measured, and demonstrated.

Data Management and Engineering Tasks and KSAs

		AVG
Tasks SPECIFIC THINGS an entry level person would BE EXPECTED TO PERFORM on the job WITH LITTLE SUPERVISION.		
Monitor, Install, Configure, Maintain		
T-1	Support maintenance of database management systems software.	2.9
T-2	Assist with monitoring and maintaining databases to ensure optimal performance.	3.4
T-3	Monitor and report the usage of knowledge management assets and resources.	2.9
T-4	Support the installation and configuration of database management systems and software.	3.0
T-5	Access database performance.	3.2
T-6	Modify software programs to improve performance.	2.7
T-7	Implement security measures for computer or information systems.	3.1
T-8	Create databases to store electronic data.	3.6
T-9	Make and test modifications to database structure when needed.	3.3
T-10	Merge old databases into new ones.	3.1
Support Database Operations		
T-11	Assist with constructing access paths to suites of information (e.g., link pages) to facilitate access by end-users.	3.1
T-12	Support directory replication services that enable information to replicate automatically from rear servers to forward units via optimized routing.	2.6
T-13	Support information exchanges through publish, subscribe, and alert functions that enable users to send and receive critical information as required.	2.8
T-14	Support the management of compilation, cataloging, caching, distribution, and retrieval of data.	3.2
T-15	Perform backup and recovery of databases to ensure data integrity.	3.4
T-16	Support configuration management, problem management, capacity management, and financial management for databases and data management systems.	2.7
T-17	Support incident management, service-level management, change management, release management, continuity management, and availability management for databases and data management systems.	3.1
T-18	Assist in managing the indexing/cataloging, storage, and access of explicit organizational knowledge (e.g., hard copy documents, digital files).	2.7
T-19	Assist in data mining and data warehousing applications.	3.0
T-20	Update computer database information.	3.3
T-21	Write computer programming code (e.g., Python and R).	3.2
T-22	Support efforts for data consistency and integration including deduplication, standardization, combining records, and database comparison.	3.0
Research/Analysis and Recommendations		
T-23	Assist with analysis and plans for anticipated changes in data capacity requirements.	2.6
T-24	Assist with developing an understanding of the needs and requirements of information for end-users.	3.5
T-25	Provide recommendations on data structures and databases that ensure correct and quality production of reports/management information.	3.1
T-26	Provide assistance in the identification of recommendations on new database technologies and architectures.	2.5
T-27	Analyze data to identify trends or relationships among variables.	3.2
Administration		
T-28	Follow data management standards, requirements, and specifications.	3.1
T-29	Develop database parameters or specifications.	3.1
T-30	Provide input for development of guidelines for system implementation.	2.4

Knowledge Knowledge focuses on the understanding of concepts. It is theoretical. An individual may have an understanding of a topic or tool or some textbook knowledge of it but have no experience applying it. For example, someone might have read hundreds of articles on health and nutrition, many of them in scientific journals, but that doesn't make that person qualified to dispense advice on nutrition.		
K-1	Knowledge of computer networking concepts and protocols, and network security methodologies.	3.4
K-2	Knowledge of risk management processes (e.g., methods for assessing and mitigating risk).	2.8
K-3	Knowledge of laws, regulations, policies, and ethics as they relate to cybersecurity and privacy.	3.1
K-4	Knowledge of Data Governance topics and their relationship to Information Governance, IT Governance, IT Service Management, Business Management PMO, Business Operations, and Risk Management.	3.0
K-5	Knowledge of Overall Data Management Maturity Model.	3.3
K-6	Knowledge of ethics.	3.3
K-7	Knowledge of data architecture frameworks such as Zachman Framework for Enterprise Architecture.	2.9
K-8	Knowledge of data modeling techniques.	3.4
K-9	Knowledge of conceptual/logical modeling.	3.1
K-10	Knowledge of physical modeling.	3.0
K-11	Knowledge of how to document the model and its use as a data governance tool.	3.0
K-12	Knowledge of data storage and operations.	3.6
K-13	Knowledge of data integration and interoperability for both structured and unstructured data.	3.5
K-14	Knowledge of cybersecurity and privacy principles.	3.2
K-15	Knowledge of cyber threats and vulnerabilities.	3.3
K-16	Knowledge of specific operational impacts of cybersecurity lapses.	3.3
K-17	Knowledge of cyber defense and vulnerability assessment tools and their capabilities.	2.9
K-18	Knowledge of data administration and data standardization policies.	3.3
K-19	Knowledge of data backup and recovery.	3.7
K-20	Knowledge of data mining and data warehousing principles.	3.5
K-21	Knowledge of database management systems, query languages, table relationships, and views.	3.8
K-22	Knowledge of digital rights management.	2.6
K-23	Knowledge of recent streaming data frameworks and protocols AMQP, (e.g., Kafka, RabbitMQ).	2.6
K-24	Knowledge of network access, identity, and access management (e.g., public key infrastructure, OAuth, OpenID, SAML, SPML).	2.7
K-25	Knowledge of operating systems (Linux, UNIX, Windows).	3.0
K-26	Knowledge of policy-based and risk adaptive access controls.	2.6
K-27	Knowledge of query languages such as SQL (structured query language).	3.7
K-28	Knowledge of sources, characteristics, and uses of the organization’s data assets.	3.2
K-29	Knowledge of the capabilities and functionality associated with content creation technologies (e.g., wikis, social networking, content management systems, blogs).	2.7
K-30	Knowledge of the capabilities and functionality associated with various technologies for organizing and managing information (e.g., databases, bookmarking engines).	3.3
K-31	Knowledge of the capabilities and functionality of various collaborative technologies (e.g., groupware, SharePoint).	2.6
K-32	Knowledge of the characteristics of physical and virtual data storage media.	3.2
K-33	Knowledge of how IT supports the organization's core business/mission processes.	3.0
K-34	Knowledge of Cloud-based knowledge management technologies and concepts related to security, governance, procurement, and administration.	3.1
K-35	Knowledge of data classification standards and methodologies based on sensitivity and other risk factors.	3.1
K-36	Knowledge of database access application programming interfaces (e.g., Java Database Connectivity [JDBC]).	3.0
K-37	Knowledge of Personally Identifiable Information (PII) data security standards.	3.3
K-38	Knowledge of Payment Card Industry (PCI) data security standards.	2.5
K-39	Knowledge of Personal Health Information (PHI) data security standards.	2.8

K-40	Knowledge of current and emerging data encryption (e.g., Column and Tablespace Encryption, file and disk encryption) security features in databases (e.g., built-in cryptographic key management features).	3.2
K-41	Knowledge of current and emerging data remediation security features in databases.	3.0
K-42	Knowledge of use cases related to collaboration and content synchronization across platforms (e.g., Mobile, PC, Cloud).	2.7
K-43	Knowledge of an organization's information classification program and procedures for information compromise.	2.8
K-44	Knowledge of the principal methods, procedures, and techniques of gathering information and producing, reporting, and sharing information.	3.5
K-45	Knowledge of data mining techniques.	3.3
K-46	Knowledge of database theory.	3.5
K-47	Knowledge of maintaining databases (i.e., backup, restore, delete data, transaction log files, etc.).	3.5
K-48	Knowledge of understanding data ownership and data stakeholders.	2.7
K-49	Knowledge of database maintenance.	3.2
K-50	Knowledge of replication services.	2.8
K-51	Knowledge of scripting languages.	3.7
Skills The capabilities or proficiencies developed through training or hands-on experience. Skills are the practical application of theoretical knowledge. Someone can take a course on investing in financial futures, and therefore has knowledge of it. But getting experience in trading these instruments adds skills.		
S-1	Skill in allocating storage capacity in the design of data management systems.	3.1
S-2	Skill in conducting information searches.	3.4
S-3	Skill in conducting knowledge mapping (e.g., map of knowledge repositories).	3.0
S-4	Skill in conducting queries and developing algorithms to analyze data structures.	3.5
S-5	Skill in generating queries and reports.	3.7
S-6	Skill in maintaining databases (i.e., backup, restore, delete data, transaction log files, etc.).	3.4
S-7	Skill in optimizing database performance.	2.9
S-8	Skill in using knowledge management technologies.	2.8
S-9	Skill in problem solving from an entry-level viewpoint: Noticing a problem and figuring out the best way to solve it. Includes investigation and evaluation of new technology against core business processes and mission.	3.7
S-10	Skill in judgment and ethical decision making: Thinking about the pros and cons of different options and picking the best one.	3.4
S-11	Skill in systems evaluation: Measuring how well a system is working and how to improve it.	3.1
S-12	Skill in programming: Writing computer programs, including scripting.	3.0
S-13	Skill in consistency when modeling data (attention to data details).	3.3
S-14	Skill in using various operating systems (e.g., Linux, UNIX, Windows).	2.3
S-15	Skill in API design to retrieve data including languages such as REST, GraphQL, and capabilities such as Power BI and Tableau.	3.2
Abilities Abilities have historically been used to describe the innate traits or talents that a person brings to a task or situation. Many people can learn to negotiate competently by acquiring knowledge about it and practicing the skills it requires. A few are brilliant negotiators because they have the innate ability to persuade. In reality, abilities may be included under skills or may be separated out.		
A-1	Ability to match the appropriate knowledge repository technology for a given application or environment.	3.3
A-2	Ability to order and arrange information.	3.6
A-3	Ability to demonstrate self-driven inquisitive data discovery.	3.3
A-4	Ability to see systems holistically (data systems rarely exist in a silo).	3.2

Data Management and Engineering Employability Skills

Workplace Professionalism & Work Ethics	Level 1 - Employee learns expectations of workplace environment (professional behavior and ethics) and adheres to practices with some guidance. Level 2 - Employee exhibits sound professionalism, judgment, and integrity and accepts responsibility for own behavior. Employee exhibits these qualities without guidance but occasionally refers to policies as needed.
Written Communication	Level 1 - Employee understands written instructions and executes tasks with guidance and feedback from supervisor. Employee clearly communicates concepts in writing. Level 2 - Employee comprehends and executes written instructions with minimal guidance. Employee composes well-organized written documents.
Oral Communication	Level 1 - Employee understands oral instructions and executes tasks with guidance and feedback from supervisor. Employee communicates concepts orally while clarifying for meaning. Employee develops listening skills. Level 2 - Employee comprehends and executes oral instructions with minimal guidance and exhibits good listening skills. Employee clarifies for meaning without needing prompting from supervisor.
Teamwork	Level 1 - With guidance and feedback from supervisor, employee obeys team rules and understands team member roles. Employee actively participates in team activities, volunteers for special tasks, and establishes rapport with co-workers. Level 2 - Employee demonstrates commitment, enthusiasm and supports team members. Employee follows up on assigned tasks and leads by example.
Problem Solving & Critical Thinking	Level 1 - Employee identifies the problem and relevant facts and principles with guidance and feedback from supervisor. Employee summarizes existing ideas and demonstrates creative thinking process while problem solving. Level 2 - With minimal supervision, employee analyzes underlying causes, considers risks and implications, and uses logic to draw conclusions. Employee applies rules and principles to processes and recommends solutions.
Organization and Planning	Level 1 - Employee prepares schedule for self, monitors and adjusts task sequence, and analyzes work assignments with guidance from supervisor. Level 2 - Employee manages timelines and recommends timeline adjustments. Employee escalates timeline-impacting issues as appropriate.
Adaptability and Flexibility	Level 1 - With guidance and feedback from supervisor, employee is able to adjust ways of doing work based on changing dynamics. Working under pressure is difficult, but employee makes it through the project with guidance and oversight. Level 2 - Employee makes inquiries of co-workers regarding possible changes needed in ways of doing work and adapts accordingly. Observes co-workers increasing work productivity under pressure and follows their lead.
Initiative	Level 1 - Employee finishes a step in a project and waits for direction before going on to the next step. Level 2 - Employee finishes multiple steps in a project and appropriately begins working on the next step without being asked.
Accuracy	Level 1 - Employee makes mistakes routinely but is committed to learning to adjust work habits to prevent them in the future. Level 2 - Employee occasionally makes mistakes but quickly makes adjustments to work habits to avoid making the same mistake twice.
Cultural Competence	Level 1 - Employee is inexperienced with working with diverse teams. With support and guidance and getting to know team members, employee develops working relationships. Level 2 - Employee is committed to working with diverse teams but struggles when differences arise. Employee identifies those challenges and works with colleagues to find ways to work effectively.
Self and Career Development	Level 1 - Employee requires feedback and direction from supervisor regarding improvement needed in professional and technical skills. Employee follows through with skills development with monitoring by supervisor. Level 2 - Employee builds upon self-assessment experience and can develop a professional and technical skills improvement plan in conjunction with supervisor. Employee completes development plan without prompting from supervisor.

Data Management and Engineering Key Performance Indicators

For the entry-level employee, all tasks are typically done under supervision for much of the first year and then with some independence with verification after the employee has more experience. All tasks are done according to company guidelines.

	Tasks	Key Performance Indicators
Monitor, Install, Configure, Maintain		
T-1	Support maintenance of database management systems software.	Monitoring is performed using criteria that are already identified and agreed upon with design and user groups and are consistent with business requirements. Performance metrics, systems usage and response times are properly monitored, recorded, and reported. Performance deviations are identified and reported for corrective measures. Database management software and other data management software are installed and configured according to plan and specifications. Database management systems are fully operational, users have proper access to data and database is accessible through the network, where applicable. Proper testing is performed and testing methods follow company guidelines. Data management software modifications are tested and applied in a timely manner with minimal disruptions to clients/users and service as directed. Security measures are followed and/or implemented to minimize unauthorized access and address security tradeoffs and risks. Users are notified about changes in their security access in accordance with company procedures. Security breaches are accurately identified and communicated effectively to appropriate personnel.
T-2	Assist with monitoring and maintaining databases to ensure optimal performance.	
T-3	Monitor and report the usage of knowledge management assets and resources.	
T-4	Support the installation and configuration of database management systems and software.	
T-5	Access database performance.	
T-6	Modify software programs to improve performance.	
T-7	Implement security measures for computer or information systems.	
T-8	Create databases to store electronic data.	
T-9	Make and test modifications to database structure when needed.	
T-10	Merge old databases into new ones.	
Support Database Operations		
T-11	Assist with constructing access paths to suites of information (e.g., link pages) to facilitate access by end-users.	Support to client/user is delivered effectively and efficiently. Directory replication services are performed efficiently. Data consistency and integration including deduplication, standardization, combining records and database comparison are performed efficiently. Internal and external feedback and user issues are presented clearly and concisely, and user questions about configuration are completely and professionally answered. Access issues are properly addressed, and ease of access is facilitated. Continuous efforts are made to identify and address problems before they become critical. Error, performance and availability metrics are accurately documented and suggestions for improvement are provided. Data management and security operations are effectively supported. Integrity errors are detected, measured, documented and demonstrate a trend of improvement and suggestions for improvement are provided. Any software created is developed using efficient software design processes and is well documented so that it can be understood by other developers. Errors in processes and tools are identified and contributions are made to analysis and resolution. Backups are consistently performed and tested for recovery based on company guidelines.
T-12	Support directory replication services that enable information to replicate automatically from rear servers to forward units via optimized routing.	
T-13	Support information exchanges through publish, subscribe, and alert functions that enable users to send and receive critical information as required.	
T-14	Support the management of compilation, cataloging, caching, distribution, and retrieval of data.	
T-15	Perform backup and recovery of databases to ensure data integrity.	
T-16	Support configuration management, problem management, capacity management, and financial management for databases and data management systems.	
T-17	Support incident management, service-level management, change management, release management, continuity management, and availability management for databases and data management systems.	
T-18	Assist in managing the indexing/cataloging, storage, and access of explicit organizational knowledge (e.g., hard copy documents, digital files).	
T-19	Assist in data mining and data warehousing applications.	
T-20	Update computer database information.	
T-21	Write computer programming code (e.g., Python and R).	
T-22	Support efforts for data consistency and integration including deduplication, standardization, combining records and database comparison.	
Research/Analysis and Recommendations		
T-23	Assist with analysis and plans for anticipated changes in data capacity requirements.	Contributions to the planning process to accommodate future capacity with respect to data and user-growth needs are made. Capacity planning utilizes the appropriate performance metrics. Analysis processes and conclusions are clearly and concisely documented. Customer requirements gathered are complete, accurate and documented in a timely manner. Proper tools and metrics are used to measure user trends. Current and emerging tools and technologies are evaluated. Continuous efforts are made to identify and address problems before they become critical. Error, performance and availability metrics are accurately documented and communicated to supervisors/team.
T-24	Assist with developing an understanding of the needs and requirements of information for end-users.	
T-25	Provide recommendations on data structures and databases that ensure correct and quality production of reports/management information.	
T-26	Provide assistance in the identification of recommendations on new database technologies and architectures.	
T-27	Analyze data to identify trends or relationships among variables.	

Administration		
T-28	Follow data management standards, requirements, and specifications.	Data management systems are monitored to check that applications meet company standards on a continuous basis. Data processes, procedures and environment configuration standards are understood and followed.
T-29	Develop database parameters or specifications.	Computer database information and specifications are clearly and concisely documented.
T-30	Provide input for development of guidelines for system implementation.	Guidelines for database application development standards are understood and followed.

Data Management and Engineering Student Learning Outcomes		
Knowledge		**Student Learning Outcomes**
K-36	Knowledge of database access application programming interfaces (e.g., Java Database Connectivity [JDBC]).	Describe how to access and connect different databases using application programming interfaces (API) and scripting languages.
K-51	Knowledge of scripting languages.	
K-33	Knowledge of how IT supports the organization's core business/mission processes.	Discuss how IT supports the organization's core business processes.
K-44	Knowledge of the principal methods, procedures, and techniques of gathering information and producing, reporting, and sharing information.	Identify methods, procedures and techniques of gathering and sharing information.
K-34	Knowledge of Cloud-based knowledge management technologies and concepts related to security, governance, procurement, and administration.	Explain different technologies and concepts as they relate to security, governance, procurement and administration in a cloud-based environment.
K-3	Knowledge of laws, regulations, policies, and ethics as they relate to cybersecurity and privacy.	Describe laws, regulations and ethical behavior related to cybersecurity and privacy.
K-14	Knowledge of cybersecurity and privacy principles.	
K-6	Knowledge of ethics.	
K-15	Knowledge of cyber threats and vulnerabilities.	Identify how to assess cyber threats and vulnerabilities.
K-16	Knowledge of specific operational impacts of cybersecurity lapses.	Describe the operational implications to the organization of cybersecurity lapses.
K-17	Knowledge of cyber defense and vulnerability assessment tools and their capabilities.	Identify capabilities of cyber defense and vulnerabilities tools.
K-37	Knowledge of Personally Identifiable Information (PII) data security standards.	Explain data security standards such as PII, PCI and PHI.
K-38	Knowledge of Payment Card Industry (PCI) data security standards.	
K-39	Knowledge of Personal Health Information (PHI) data security standards.	
K-7	Knowledge of data architecture frameworks such as Zachman Framework for Enterprise Architecture.	Describe different data architecture frameworks and protocols for data governance.
K-23	Knowledge of recent streaming data frameworks and protocols AMQP, (e.g. Kafka, RabbitMQ).	
K-31	Knowledge of the capabilities and functionality of various collaborative technologies (e.g., groupware, SharePoint).	Compare and contrast capabilities and functionality of different collaborative technologies.
K-42	Knowledge of use cases related to collaboration and content synchronization across platforms (e.g., Mobile, PC, Cloud).	Discuss collaboration and content synchronization use cases across hardware platforms.
K-46	Knowledge of database theory.	Explain relevant database theories.
K-19	Knowledge of data backup and recovery.	Identify the data backup and recovery processes.
K-4	Knowledge of Data Governance topics and their relationship to Information Governance, IT Governance, IT Service Management, Business Management PMO, Business Operations, and Risk Management.	Discuss the role of data governance and it's relationship to an organization's business operations.
K-5	Knowledge of Overall Data Management Maturity Model.	Explain how an organization's Data Management Maturity Model (DMMM) helps benchmark organizational performance.
K-18	Knowledge of data administration and data standardization policies.	Discuss data administration and standardization policies.
K-22	Knowledge of digital rights management.	List and describe the organization's data assets and digital rights management.
K-28	Knowledge of sources, characteristics, and uses of the organization’s data assets.	
K-48	Knowledge of understanding data ownership and data stakeholders.	Differentiate between data owner and data stakeholder.
K-47	Knowledge of maintaining databases (i.e., backup, restore, delete data, transaction log files, etc.).	Maintain databases by updating, adding, deleting and appending records as necessary for business operations.
K-49	Knowledge of database maintenance.	
K-50	Knowledge of replication services.	Describe the process of data replication services.
K-8	Knowledge of Data Modeling Techniques.	State and describe different data modeling methodologies and capabilities for organizing and managing information.
K-30	Knowledge of the capabilities and functionality associated with various technologies for organizing and managing information (e.g., databases, bookmarking engines).	
K-9	Knowledge of conceptual/logical modeling.	Compare and contrast the conceptual, logical and physical data models and document its use in a data governance tool.
K-10	Knowledge of physical modeling.	
K-11	Knowledge of how to document the model and its use as a data governance tool.	
K-45	Knowledge of data mining techniques.	Explain data mining and data warehousing principles and techniques.
K-20	Knowledge of data mining and data warehousing principles.	
K-35	Knowledge of data classification standards and methodologies based on sensitivity and other risk factors.	Explain different data classification standards and methodologies based on sensitivity and risk factors.
K-41	Knowledge of current and emerging data remediation security features in databases.	Identify current and emerging database security features. Explain the organization's IT security and privacy policies and procedures for data governance.
K-43	Knowledge of an organization's information classification program and procedures for information compromise.	

K-12	Knowledge of Data Storage and Operations.	Explain data storage operations including physical and virtual data storage media.
K-32	Knowledge of the characteristics of physical and virtual data storage media.	
K-29	Knowledge of the capabilities and functionality associated with content creation technologies (e.g., wikis, social networking, content management systems, blogs).	Describe the capabilities and functionality associated with content creation technologies.
K-40	Knowledge of current and emerging data encryption (e.g., Column and Tablespace Encryption, file and disk encryption) security features in databases (e.g., built-in cryptographic key management features).	Identify and describe various current information technologies and emerging database security principles and methods.
K-1	Knowledge of computer networking concepts and protocols, and network security methodologies.	Identify security methodologies using different networking environments and protocols.
K-24	Knowledge of network access, identity, and access management (e.g., public key infrastructure, OAuth, OpenID, SAML, SPML).	Explain the importance of network identity and access management policies and risk controls.
K-26	Knowledge of policy-based and risk adaptive access controls.	
K-25	Knowledge of operating systems (Linux, UNIX, Windows).	Explain the usage of different operating systems.
K-21	Knowledge of database management systems, query languages, table relationships, and views.	Describe the use and function of database management systems, query languages, table relationships, and views.
K-27	Knowledge of query languages such as SQL (structured query language).	
K-2	Knowledge of risk management processes (e.g., methods for assessing and mitigating risk).	Outline information security principles and processes.
K-13	Knowledge of data integration and interoperability for both structured and unstructured data.	Explain the process of integrating and interoperability of structured and unstructured databases.
Skills		**Student Learning Outcomes**
S-4	Skill in conducting queries and developing algorithms to analyze data structures.	Perform queries and develop reports to analyze data.
S-5	Skill in generating queries and reports.	
S-10	Skill in judgment and ethical decision making: Thinking about the pros and cons of different options and picking the best one.	Use and justify proper judgement while using pros and cons of different options when making an ethical decision.
S-6	Skill in maintaining databases (i.e., backup, restore, delete data, transaction log files, etc.).	Operate databases by updating, adding, deleting and appending records as necessary for business operations.
S-3	Skill in conducting knowledge mapping (e.g., map of knowledge repositories).	Build and sketch a knowledge management map of an organization's knowledge repositories.
S-8	Skill in using knowledge management technologies.	
S-13	Skill in consistency when modeling data (attention to data details).	Apply consistency when designing data modeling.
S-1	Skill in allocating storage capacity in the design of data management systems.	Employ data storage capacity when designing data management systems.
S-14	Skill in using various operating systems (e.g., Linux, UNIX, Windows).	Demonstrate the use of appropriate operating systems to solve a problem.
S-11	Skill in systems evaluation: Measuring how well a system is working and how to improve it.	Create and maintain an effective system performance baseline measure to identify and improve system performance.
S-7	Skill in optimizing database performance.	
S-9	Skill in problem solving from an entry-level viewpoint: Noticing a problem and figuring out the best way to solve it. Includes investigation and evaluation of new technology against core business processes and mission.	Apply troubleshooting skills by investigating and evaluating new technologies to solve a problem.
S-12	Skill in programming: Writing computer programs, including scripting.	Write code to access, connect and retrieve data from different databases using application programming interfaces(API) and scripting languages.
S-15	Skill in API design to retrieve data including languages such as REST, GraphQL, and capabilities such as Power BI and Tableau.	
S-2	Skill in conducting information searches.	Conduct information searches as necessary to solve a problem.
Abilities		**Student Learning Outcomes**
A-1	Ability to match the appropriate knowledge repository technology for a given application or environment.	Choose appropriate knowledge repository technology for a given environment.
A-2	Ability to order and arrange information.	Evaluate and assemble information in proper order.
A-3	Ability to demonstrate self-driven inquisitive data discovery.	Independently seeks and discovers relevant data.
A-4	Ability to see systems holistically (data systems rarely exist in a silo).	Construct a holistic view of data systems.