Next Generation Higher National Unit Specification

Database Design Fundamentals (SCQF level 7)

Unit code: J8FK 47

SCQF level: 7 (8 SCQF credit points)

Valid from: session 2024 to 2025

Prototype unit specification for use in pilot delivery only (version 1.0) August 2024

This unit specification provides detailed information about the unit to ensure consistent and transparent assessment year on year. It is for lecturers and assessors and contains all the mandatory information you need to deliver and assess the unit.

This edition: August 2024 (version 1.0)

Unit purpose

This unit provides learners with the knowledge and skills they need to design, create, maintain and interrogate a database using a relational database management system (RDBMS). Learners use structured query language (SQL) queries to interact with an RDBMS to analyse data and generate reports. These skills enable them to administer databases in a commercial environment. The unit is suitable for learners who are studying software development or data science.

Entry to the unit is at your centre's discretion. Learners don't need any prior knowledge, but they should be able to use computer software applications.

The unit gives learners important knowledge and skills in designing a suitable structure to maintain and update real-world information systems.

Learners can progress to further study at SCQF level 8 or above in database application development or SQL.

Unit outcomes

Learners who complete this unit can:

1 explain the purpose of a database and its components
2 create an entity-relationship diagram, its corresponding relational model, and a normalised set of tables
3 write SQL queries to maintain data in an RDBMS
4 ensure a database is secure

Evidence requirements

Learners must provide knowledge evidence and product evidence.

Knowledge evidence

The knowledge evidence relates to outcome 1. Evidence is required for all knowledge statements in the 'Knowledge and skills' section. Learners must demonstrate the following knowledge:

- the difference between data and information
- the range of data types and their storage requirements
- the purpose of a database including the storage, organisation and analysis of data
- relational database concepts, including tables and relationships
- keys as unique identifiers for records in a database
- the constraints on transactions processed on a database

Sampling is allowed in certain circumstances. You can use a test to sample knowledge evidence. If you use a test, it must be under supervised conditions, and controlled in terms of location and timing. Learners are not permitted access to reference material.

Knowledge evidence can be written, oral or a combination of these. Learners can capture, store and present evidence in a range of media (including audio and video) and formats (analogue and digital).

Product evidence

Learners must provide:

- a set of tables, normalised to a required standard, that eliminates data redundancy and ensures data integrity
- a relational model derived from given third normal form (3NF) relations, identifying primary and foreign keys and relationships between tables
- a database structure that corresponds with a relational model and contains data tables populated with test data
- output from a set of SQL SELECT statements that perform required create, read, update and delete (CRUD) operations on a database structure
- screenshots that evidence security operations on a database

Authentication is required where the evidence is produced in lightly-controlled conditions. The standard of evidence should be consistent with the SCQF level of the unit.

Knowledge and skills

Knowledge	Skills
Learners should understand: ♦ information and data ♦ data types ♦ purpose of a database ♦ components of a database ♦ relational database concepts ♦ keys (primary and foreign) and indexes ♦ entity relationship modelling ♦ database schemas ♦ normalised forms to 3NF ♦ SQL basic syntax and structure ♦ SQL and databases ♦ use of SQL to manipulate a database ♦ types of join ♦ security measures to protect a database	Learners can: ♦ normalise data to a required standard ♦ construct a data model from 3NF relations ♦ produce a data dictionary for a set of entities ♦ populate tables with records ♦ update tables according to user requirements ♦ create constraints and primary keys within tables ♦ use SQL to create queries to meet user requirements ♦ sort, update and delete data records to meet user requirements ♦ incorporate calculations within queries ♦ create queries that 'join' more than one table in a SELECT statement ♦ produce formatted query responses ♦ secure a database from unauthorised access or change

Meta-skills

You must give learners opportunities to develop their meta-skills throughout this unit. We've suggested how to incorporate the most relevant ones into the unit content, but you may find other opportunities.

Self-management

This includes focusing, integrity, adapting and initiative. The most relevant are:

- focusing:
  - prioritising tasks
  - managing deadlines
  - allocating resources
- adapting:
  - embracing change by learning and adopting new tools
- initiative:
  - leadership skills, including motivating and influencing others, and setting a positive example

Social intelligence

This includes communicating, feeling, collaborating and leading. The most relevant are:

- communicating:
  - conveying technical information clearly to both technical and non-technical stakeholders
- feeling:
  - creating a positive environment by understanding the perspectives and feelings of others, particularly in relation to the experiences and concerns of other learners
- collaborating:
  - discussing different aspects of the coursework and actively listening to the opinions of others
  - collaborating and working effectively with people from different backgrounds, respecting their knowledge, and achieving shared goals

Innovation

This includes curiosity, creativity, sense-making and critical thinking. The most relevant are:

- sense-making:
  - problem solving, for example deriving the 3NF for a set of data
- critical thinking:
  - evaluating information and making informed decisions

Learning for Sustainability

Throughout this unit, you should encourage learners to develop their skills, knowledge and understanding of sustainability.

This includes:

- a general understanding of social, economic and environmental sustainability
- a general understanding of the United Nations Sustainable Development Goals (SDGs)
- a deeper understanding of subject-specific sustainability
- the confidence to apply the skills, knowledge, understanding and values they develop in the next stage of their life

You should emphasise the role that relational database structures play in reducing the amount of storage required and enabling efficiency in data queries and reporting. This relates to SDG 9.

Delivery of unit

This unit is an optional unit in Higher National Certificate (HNC) Computing at SCQF level 7. You should offer the unit when learners have the basic knowledge and skills they need to successfully engage with it.

We suggest the following distribution of time, including assessment:

Outcome 1 — Explain the purpose of a database and its components
(5 hours)
Outcome 2 — Create an entity-relationship diagram, its corresponding relational model, and a normalised set of tables
(15 hours)
Outcome 3 — Write SQL queries to maintain data in an RDBMS
(15 hours)
Outcome 4 — Ensure a database is secure
(15 hours)

Additional guidance

The guidance in this section is not mandatory.

Content and context for this unit

If you deliver the unit as part of a qualification, we recommend that you teach and assess it in the context of the qualification.

You should introduce learners to the basic principles and procedures involved in developing robust, reliable and efficient database structures using an RDBMS. You should aim to help learners gain competence in the design and development of a relational database structure, ensuring that they observe good practice throughout.

As this is an introductory unit in RDBMS, you should use contexts and examples that are relatively simple and relate to learners' vocational experience. By using this approach, you help learners to concentrate more on the techniques involved, rather than requiring a solution to an initial problem.

On completing the unit, learners should have achieved a good foundation in the knowledge and competence required for developing reliable and efficient RDBMS structures that solve business problems and meet user requirements.

Resources

You should make use of the provision made by commercial suppliers of RDBMS that allows learners and teachers free or reduced cost access to the basic functionality of their systems. Examples of this include:

- Oracle MySQL Community Edition
- Microsoft (SQL Server)
- IBM Academic Initiative (Db2)
- Microsoft Azure for Students (Azure SQL Database)
- Amazon Web Services (AWS) Educate (Amazon Relational Database Service (Amazon RDS))

You can also use open-source solutions, such as PostgreSQL.

These commercial organisations also provide free online training in aspects of their RDBMS systems, which may be useful to learners during their studies.

Approaches to delivery

You should begin with an overview of databases, data types, and their importance to organisations and businesses, and ensure that learners understand the purpose that databases serve.

You should build on your overview by further explaining the components of a database, including:

- tables, rows, and columns
- keys (primary and foreign)
- indexes
- relationships, and normalised forms (up to 3NF)

This leads to practical exercises in creating simple tables and defining primary keys and relationships.

Next, you should demonstrate how to create entity relationship diagrams (ERDs) to represent data relationships, followed by teaching learners about entities, attributes and relationships. You should provide learners with opportunities to convert ERDs to relational models using example scenarios. You should choose these carefully to reflect learners' own areas of interest.

You can now develop the topic of normalisation and explain how to apply normalisation rules to eliminate redundancy. Provide hands-on practice in creating normalised tables and developing a data dictionary.

Depending on which RDBMS platform you have chosen, you should introduce the SQL and explain its syntax and relationship to databases. You should provide practice for learners to construct basic SQL queries using SELECT, INSERT, UPDATE, and DELETE and use these with provided database examples. Next, you should demonstrate to learners how they can use SQL statements to:

- populate tables with records
- update data based on user requirements
- delete records
- perform calculations (for example, aggregates)

You should take time to explain the installation and configuration of the RDBMS you have chosen (such as MySQL, PostgreSQL or SQL Server) and the step-by-step process for learners to access the RDBMS.

Finally, you should cover security considerations in the use and manipulation of data in databases. You should explain the importance of authentication, authorisation and data encryption. Demonstrate how to create user accounts and set permissions.

You should also consider:

- practical labs: include hands-on labs where learners practise creating tables, writing SQL queries and securing databases
- case studies: use real-world scenarios (for example, inventory management or student enrolment) to reinforce concepts
- guest speakers: invite industry professionals to share their experiences with database design and RDBMS
- online resources: provide links to online tutorials, documentation and practice platforms

Approaches to assessment

The assessment evidence for the unit consists of both knowledge and product evidence.

Knowledge evidence

Knowledge evidence can be generated by a knowledge test in lightly-controlled conditions, The test must cover the knowledge set out in the 'Evidence requirements' section.

Learners can also evidence knowledge by producing blog posts or video presentations that relate to the knowledge elements in the unit.

Authentication is required where the evidence is produced in lightly-controlled conditions.

Product evidence

We recommend that you facilitate a coherent learning and assessment experience by presenting learners with a project, case study or scenario covering all the requirements of the outcomes. Evidence may also be generated from a series of individual assessment tasks.

For outcome 2, you should construct the assessment to ensure that normalisation of the data produces, as a minimum, three tables to incorporate into the RDBMS. You must also ensure that the normalised tables contain a cross-section of the most commonly encountered data types.

For outcome 3, you should set out requirements that enable learners to evidence their knowledge and skills in the use of SQL by:

- populating tables with records conforming to the data dictionary created in outcome 2
- writing SQL statements to search, interrogate and modify the tables, according to user requirements

Learners can provide evidence for outcome 3 by producing printouts listing the table structures and the table contents to meet the user requirements. It is not acceptable to use automated or artificial intelligence (AI) generators for this assessment.

For outcome 4, evidence takes the form of screenshots showing security operations on a database, such as encryption of sensitive data in columns (for example, using passwords)

and the restriction of unauthorised access to the database through password-protected accounts.

These assessments are open book but must be carried out in lightly-controlled conditions, with authentication.

Equality and inclusion

This unit is designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

You must consider the needs of individual learners when planning learning experiences, selecting assessment methods or considering alternative evidence.

Guidance on assessment arrangements for disabled learners and those with additional support needs is available on the assessment arrangements web page.

Information for learners

Database Design Fundamentals (SCQF level 7)

This information explains:

- what the unit is about
- what you should know or be able to do before you start
- what you need to do during the unit
- opportunities for further learning and employment

Unit information

In this unit, you gain the knowledge and skills you need to create a normalised relational database management system (RDBMS) structure from first principles. To achieve this, you require access to a workstation and to a suitable SQL-based RDBMS applications package.

You do not need previous knowledge or experience of databases before you start the unit, but it is beneficial if you have some knowledge of computer software and a basic understanding of data.

You encounter two major areas of learning. First, how to break down a data problem into identifiable and manageable steps, from which you develop the required database structure. Secondly, you learn the syntax, functions and structures of SQL, with which you can manipulate a database and implement a solution. You reinforce your understanding and grasp of these skills and techniques with practical exercises.

You are assessed through a series of practical exercises that enable you to demonstrate competence in designing a normalised and efficient database structure, and then manipulating or interrogating the database using SQL statements to produce a required output. You also demonstrate that your database is secured against unauthorised access. Your understanding of the knowledge elements in the unit is assessed by a test, which may be written, oral or a combination of these.

On successful completion of the unit you can perform database administration in a practical setting or go on to further study in database design or advanced SQL applications. You can:

1 explain the purpose of a database and its components
2 create an entity-relationship diagram, its corresponding relational model, and a normalised set of tables
3 write SQL queries to maintain data in an RDBMS
4 ensure a database is secure

Meta-skills

Throughout this unit, you develop meta-skills for the computing sector.

Meta-skills are transferable behaviours and abilities that help you adapt and succeed in life, study and work. There are three categories of meta-skills: self-management, social intelligence and innovation.

Self-management

This includes focusing, integrity, adapting and initiative.

Social intelligence

This includes communicating, feeling, collaborating and leading.

Innovation

This includes curiosity, creativity, sense-making and critical thinking.

Learning for Sustainability

Throughout this unit, you develop skills, knowledge and understanding of sustainability.

You learn about social, economic and environmental sustainability principles and how they relate to the computing sector. You also develop an understanding of the United Nations Sustainable Development Goals.

You learn to appreciate the role that relational database structures play in reducing the amount of storage required for data and enabling efficiency in data queries and reporting. This relates to SDG 9.

Administrative information

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Superclass: CB

History of changes

Version	Description of change	Date

Please check SQA's website to ensure you are using the most up-to-date version of this document.