

BCS LEVEL 6 PROFESSIONAL GRADUATE DIPLOMA IN IT ADVANCED DATABASE MANAGEMENT SYSTEMS

SYLLABUS

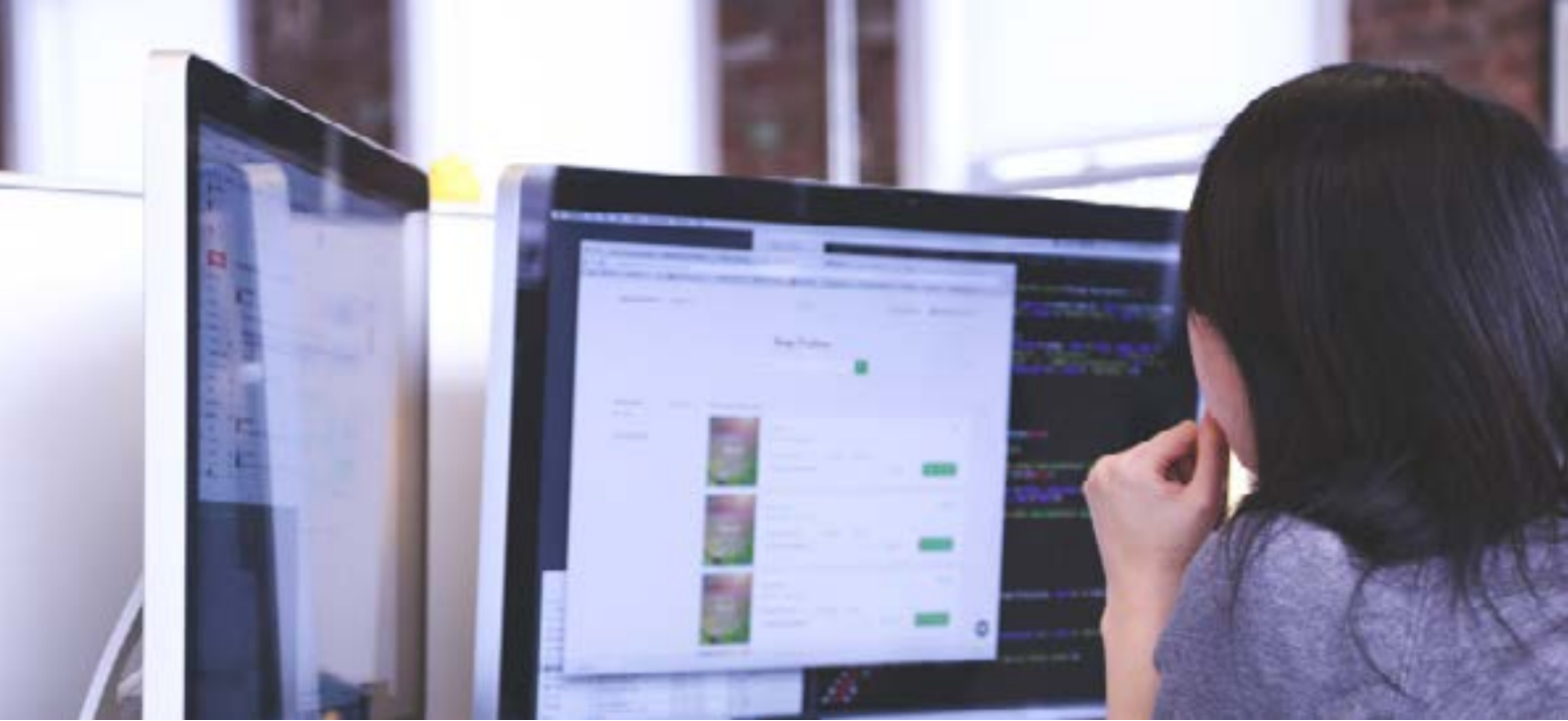


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Introduction

The final stage within the BCS three-stage Higher Education Qualification programme, the Level 6 Professional Graduate Diploma (PGD) enables candidates who have already achieved the Level 5 Diploma in IT to gain depth of knowledge and expertise in their field.

Our modules have been created in-line with the SFIAPlus framework and latest developments in the industry, giving you a competitive edge in the IT job market and showing your dedication to the industry. You will have the opportunity to learn about topics such as advanced database management, network information systems, web engineering and programming paradigms, as well as to build upon knowledge and skills developed during the Level 5 Diploma.

To successfully achieve the qualification, candidates need to complete:

- One core module (Professional Project in IT)
- Four optional modules

Depending on entrance conditions, completing the Level 6 PGD in IT may support entry onto a Master's degree course at selected global universities.

Advanced Database Management Systems optional module

The Advanced Database Management Systems module is an optional module that forms part of the Level 6 PGD in IT – the final stage within the BCS three-stage Higher Education Qualification programme.

Candidates will be given a detailed insight into relational systems and how to implement them. The module will also develop candidates' knowledge of current themes and advances in relational database systems. Furthermore, candidates will evaluate emerging architectures for database management systems and further develop their understanding of the impact that emerging database standards may have on facilities provided by future database management systems.

Qualification Suitability and Overview

Candidates must have achieved the Diploma in IT or have an appropriate exemption in order to be entered for the Professional Graduate Diploma (PGD). Candidates can study for this PGD by attending a training course provided by a BCS accredited Training Provider or through self-study, although it is strongly recommended that all candidates register with an approved centre. Studying with an approved centre will deliver significant benefits.

Candidates are required to become a member of BCS, The Chartered Institute for IT, to sit and be awarded the qualifications. Candidates may apply for a four-year student membership that will support them throughout their studies.

The Level 6 PGD is suitable for professionals wishing to gain an advanced formal IT qualification, and this module may be particularly relevant for candidates interested in career opportunities such as data science, informatics and data engineering.

Total Qualification Time (Certificate)	Guided Learning Hours (Module)	Assessment Time (Exam)
1414 hours	250 hours	Three hours

SFIA Levels

This award provides candidates with the level of knowledge highlighted within the table, enabling candidates to develop the skills to operate successfully at the levels of responsibility indicated.

Level	Levels of Knowledge	Levels of Skill and Responsibility (SFIA)
K7		Set strategy, inspire and mobilise
K6	Evaluate	Initiate and influence
K5	Synthesise	Ensure and advise
K4	Analyse	Enable
K3	Apply	Apply
K2	Understand	Assist
K1	Remember	Follow

SFIA Plus

This syllabus has been linked to the SFIA knowledge skills and behaviours required at Level 6.

DBAD4

Uses database management system software and tools, and knowledge of logical database schemata, to investigate problems and collect performance statistics and create reports. Carries out routine configuration, installation, and reconfiguration of database and related products. Develops and configures tools to enable automation of database administration tasks. Identify problems and issues and recommend corrective actions.

DTAN4

Investigates corporate data requirements, and applies data analysis, design, modelling, and quality assurance techniques, to establish, modify or maintain data structures and their associated components (entity descriptions, relationship descriptions, attribute definitions). Provides advice and guidance to database designers and others using the data structures and associated components.

DBDS4

Develops and maintains specialist knowledge of database and data warehouse concepts, design principles, architectures, software and facilities. Assesses proposed changes to object/data structures, in order to evaluate alternative options. Implements physical database designs to support transactional data requirements for performance and availability. Implements data warehouse designs that support demands for business intelligence and data analytics.

Further detail around the SFIA Levels can be found at www.bcs.org/levels.

Learning Outcomes

Upon completion of this module, candidates will be able to:

- Critically assess new developments in database technology.
 - Interpret and explain the impact of emerging database standards.
 - Evaluate the contribution of database theory to practical implementations of database management systems.
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Syllabus

1. Relational theory and concepts

Learners will be able to:

1.1 Explain theoretical concepts.

Indicative content

- a. Theoretical foundations of relational systems.

Guidance

Candidates will be required to have knowledge of relational algebra, tuple relational calculus, and relational model conformity. They should also understand the value of integrity constraints and be well-practised in design approaches and implications of design techniques on table design.

1.2 Describe the relational model.

Indicative content

- a. Conformity and integrity.
- b. Use of constraints.
- c. Mapping design approaches, such as entity relationship modelling to relational systems.

Guidance

Candidates should be able to evaluate the relational model and discuss physical mapping techniques.

2. Processing database data

Learners will be able to:

2.1 Describe advanced SQL programming.

Indicative content

- a. Using advanced SQL techniques when querying and manipulating data and data objects.

Guidance

Candidates should have detailed knowledge of the limitations of SQL and the role of stored procedures and triggers in database applications. They should build on their knowledge of basic constructs such as joins and subqueries and be able to evaluate a range of alternative solutions to query requirements.

2.2 Explain query optimisation.

Indicative content

- a. Query transformations.
- b. Optimisation approaches.
- c. Use of constraints.
- d. Creation and use of a variety of index structures and mechanisms.

Guidance

Candidates should be able to demonstrate an understanding of how optimisers work. This includes the ability to transform query specifications, use appropriate indexes and constraints to perform efficient retrieval of data. Candidates will also need to analyse query trees and simple execution plans.

2.3 Demonstrate an understanding of concurrency control, transaction management and recovery techniques.

Indicative content

- a. The ACID principle.
- b. Two-phase locking and deadlocks.
- c. Recovery procedures.
- d. Transaction design.
- e. Lock granularity.
- f. Optimistic and pessimistic approaches to locking.

Guidance

Candidates should have a detailed knowledge of the ANSI ACID principle for transactions - particularly the isolation levels, as these are markedly different in the leading databases. Candidates should be familiar with the tools available for backing up and recovering the database, in order to achieve fault tolerance of a range of failures, such as transaction, process, system, media, and site.

2.4 Describe database server tuning.

Indicative content

- a. Maximising storage and memory usage.
- b. Memory components and caching techniques.
- c. Indexing.
- d. Hashing techniques.

Guidance

This area is mainly relevant to administration and the Database Administrator. Balancing system resource usage is an important part of tuning the database. Candidates should have a firm understanding of important aspects, such as using appropriate storage technology, and techniques, such as data compression.

2.5 Explain distributed relational systems.

Indicative content

- a. Data replication:
 - i. Synchronous.
 - ii. Asynchronous.
- b. The Two-Phase Commit protocol and its weaknesses.
- c. Implications for cloud storage.
- d. Fragmentation strategies.
- e. Distributed locking strategies.
- f. Optimisation approaches.

Guidance

Candidates should be able to distinguish between truly distributed databases (as in C. J. Date's twelve rules), and those which only partially implement them - often involving replication techniques. Candidates should have a solid understanding of network issues and protocols such as Two-Phase commit.

3. Post-relational systems

Learners will be able to:

3.1 Compare different types of database management systems.

Indicative content

- a. Object oriented database management systems.
- b. Deductive database management systems.
- c. Spatial and graph database management systems.
- d. Temporal database management systems.
- e. New database applications and architectures, e.g.:
 - Multimedia.
 - Mobility.
 - NoSQL.
 - Document-oriented databases.
 - Statistical databases.

Guidance

Candidates should understand the reasons behind development of and the perceived need for object support within the database. They should be familiar with Object-relational systems and reasons for using them.

Candidates should also recognise the limitations of relational systems and the way in which new technologies such as NoSQL, document-oriented, and key-value pair databases attempt to alleviate some of the issues.

They should be able to demonstrate their understanding of special purpose database systems as alternatives and relational models to handle temporal, spatial and multimedia databases.

4. Database security

Learners will be able to:

4.1 Analyse database security and privacy methods and techniques.

Indicative content

- a. Data encryption and decryption.
- b. Redaction and masking techniques.
- c. Authentication and authorisation.
- d. Database auditing and archiving.
- e. Cyber security vs. data security.

Guidance

This is an increasingly important area for data professionals, covering an increasing array of technologies. Candidates should have a firm understanding of password control and identification techniques, as well as authorisation controls such as roles and privileges. They will also need to appreciate the responsibilities of a Database Security Administrator. Cyber security describes the way an organisation protects its online assets from different kinds of threats.

5. Data warehouse and data mining

Learners will be able to:

5.1 Compare different approaches for modelling and storing historical data.

Indicative content

- a. Schema design, e.g. star vs. snowflake.
- b. OLAP vs. OLTP and denormalisation issues.
- c. Extraction, transformation and loading (ETL/ELT).
- d. Slowly changing dimensions.
- e. Table partitioning.
- f. Multidimensional databases, e.g. cubes, aggregation.
- g. Time series analysis.
- h. Analytic (windowing) functions.
- i. Resource issues.
- j. Data mining capabilities and applications.
- k. Data mining and data warehouse integration and support.

Guidance

Data warehousing involves the storage of large amounts of mainly historical data which can be used for market and trend analysis. Data warehouses are mainly query-only, which allows different design opportunities, in contrast to operational databases. They are often denormalised and carefully indexed to maintain performance as the data grows. Candidates would be expected to explain why different schemas exist, how table partitioning can be used to organise data for efficient retrieval, and how to cope with the issue of slowly changing dimensions. They should also be aware of the complexities around ETL/ELT and populating a data warehouse.

Examination Format

This module is assessed through completion of an invigilated written exam.

Type	Three written questions from a choice of five, each with equal marks
Duration	Three hours
Supervised	Yes
Open Book	No (no materials can be taken into the examination room)
Passmark	10/25 (40%)
Delivery	Paper format only

Adjustments and/or additional time can be requested in line with the BCS reasonable adjustments policy for candidates with a disability or other special considerations.

Question Weighting

Candidates will choose three questions from a choice of five. All questions are equally weighted and worth 25 marks.

Recommended Reading

Primary texts

Title: An Introduction to Database Systems (eighth edition)
Author: C. J. Date
Publisher: Addison-Wesley Longman
Date: 2003
ISBN: 978-0321197849

Title: Database System Concepts (sixth edition)
Author: A. Silberschatz, H. Korth and S. Sudarshan
Publisher: McGraw-Hill
Date: 2010
ISBN: 978-0073523323

Title: Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data
Author: W. Lemahieu, S. vanden Broucke and B. Baesens
Publisher: Cambridge University Press
Date: 2018
ISBN: 978-1107186125

Title: Database Systems: Practical approach to design, implementation, and management (sixth edition)
Author: T. M. Connolly and C. Begg
Publisher: Pearson Education
Date: 2015
ISBN: 978-1292061184

Additional texts and resources

Title: SQL 1999: Understanding Relational Language Components
Author: J. Melton and A. Simon
Publisher: Morgan-Kaufmann
Date: 2003
ISBN: 978-1558604568

Title: The Ultimate Guide from Beginner to Expert - Learn and Master SQL in No Time
Author: P. Adams
Publisher: Addison Wesley
Date: 2016
ISBN: 978-1540700520

Title: Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems
Author: M. Kleppmann
Publisher: O'Reilly
Date: 2017
ISBN: 978-1449373320

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Document Change History

Any changes made to the syllabus shall be clearly documented with a change history log. This shall include the latest version number, date of the amendment and changes made. The purpose is to identify quickly what changes have been made.

Version Number	Changes Made
Version 1.0 July 2021	Document creation.
Version 2.0	Syllabus updated following review.
Version 3.0	Syllabus updated following review.
Version 4.0	Updates made based on review by moderators and examiners.
Version 5.0	Changes made to date following 2022 refresh.
Version 5.1	Green band added to LO 5.

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