

BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 6 Professional Graduate Diploma in IT

ADVANCED DATABASE MANAGEMENT SYSTEMS

Friday 17th April 2026 – Afternoon

Answer **any** THREE questions out of FIVE. All questions carry equal marks.

Time: THREE hours

Answer any Section A questions you attempt in Answer Book A

Answer any Section B questions you attempt in Answer Book B

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are NOT allowed in this examination.

Section A
Answer Section A questions in Answer Book A

A1.

- a) Data mining is widely applied across industries to transform large data sets into information upon which actions can be based.
- i. Define data mining and explain **two** key capabilities that make data mining a powerful tool for analysing large datasets.
(4 marks)
 - ii. Choose an application of data mining (e.g. in healthcare, finance, retail, etc.). Then within the scope of that application, discuss the type of data typically used, the primary goals or outcomes expected from data mining and **one** specific data mining technique commonly employed for this purpose.
(6 marks)
 - iii. Explain why ethical considerations must be taken into account when applying data mining in fields that handle sensitive information, such as healthcare or finance. Provide an example of potential risks and how they can be mitigated.
(5 marks)
- b) Define the ETL process and briefly explain the purpose of each stage: extraction, transformation and loading.
(6 marks)
- c) Compare and contrast ETL with ELT (extract, load, transform). Under what circumstances might ELT be a preferred approach over ETL?
(4 marks)

A2.

- a) Consider the following SQL query that retrieves data from a university database consisting of two tables:

Students and Enrolments. The Students table contains student information, including studentID, name and major. The Enrolments table includes enrolmentID, studentID, courseID and grade.

```
SELECT s.name, e.courseID, e.grade
FROM Students s
JOIN Enrolments e ON s.studentID = e.studentID
WHERE s.major = 'Computer Science'
ORDER BY e.grade DESC;
```

- i. Draw an initial query tree for the above SQL query.

(6 marks)

- ii. The positioning of join operations in the sequence of steps used in the processing of query can affect performance of the query.

Describe **two** alternative sequences of the steps used in the process that could improve performance. Explain why they might be beneficial and rewrite the SQL.

(8 marks)

- b) Integrity constraints help with the reliability of relational database systems, but they can also positively impact the performance. Briefly consider how foreign key constraints can help improve performance.

(2 marks)

- c) Indexing is a critical technique for tuning database performance, particularly for query optimisation in large databases.

- i. Define indexing in the context of Database Management Systems (DBMS) and explain how an index improves query performance.

(3 marks)

- ii. Identify and explain **two** situations where indexing may decrease performance or be counterproductive.

(6 marks)

[Turn Over]

A3.

a) You are responsible for designing a secure information system for a healthcare organisation that handles sensitive patient data, including medical histories, treatment records and personal information.

- i. Describe a comprehensive authentication mechanism that you would implement for this healthcare system. Discuss at least **two** methods you would use to verify the identity of users (e.g. doctors, nurses, administrative staff).

(4 marks)

- ii. Explain how you would implement authorisation within the system. Describe how permissions would be assigned based on the roles of healthcare provider, administrative staff and patients.

(5 marks)

- iii. Outline an encryption strategy to protect sensitive patient data both at rest and in transit. Discuss the types of data that should be encrypted and the encryption methods you would recommend.

(4 marks)

- iv. Discuss the auditing process you would establish for the healthcare information system. What specific events would you log (e.g. access to patient records, changes to data) and how would you ensure that these logs are secure and tamper-proof?

(4 marks)

b) In a healthcare organisation, there are two distinct user roles: healthcare providers (doctors and nurses) and administrative staff. Each role has different access needs regarding patient data due to privacy concerns and regulatory compliance.

Healthcare providers need access to comprehensive patient medical records to provide care, while administrative staff only need access to non-sensitive patient information for tasks like scheduling appointments and managing patient demographics (personal information).

Write SQL `CREATE VIEW` statements to create **two** views based on the requirements below:

- i. `PatientRecordsView`: This view will be accessible only to healthcare providers and will include sensitive medical information such as patient medical histories, treatment plans and medications.

(4 marks)

- ii. `PatientDemographicsView`: This view will be accessible only to administrative staff and will contain non-sensitive information such as patient names, contact information and appointment details.

(4 marks)

Section B
Answer Section B questions in Answer Book B

B4.

- a) A university wants to implement an object-oriented database system to manage information about its courses, students and faculty. Each course is taught by a faculty member, has a list of enrolled students and includes information such as course name, course code and credits. Each student has a unique ID, name, subject of study and a list of courses they are enrolled in. Faculty members also have unique IDs, names, departments and a list of courses they teach.
- i. Design an object-oriented database view to represent the university's system by:
 - Defining classes for student, course and faculty.
 - Including appropriate attributes for each class and specifying any relationships between classes.

(6 marks)
 - ii. Explain how inheritance or polymorphism might be used to extend this database model if the university decides to include additional roles, such as teaching assistants who can assist with courses but also have student attributes (e.g. enrolled courses).

(5 marks)
 - iii. Discuss **two** advantages of using an object-oriented database model for this university system, compared to a relational database model.

(4 marks)
- b) Asynchronous data replication is a key strategy in distributed relational database systems to maintain data consistency and improve availability.
- i. Define asynchronous data replication, considering data consistency and latency.

(3 marks)
 - ii. Describe a scenario in which asynchronous data replication might be preferred over synchronous replication. In your answer, include details about the type of application and the impact on data availability and consistency.

(7 marks)

[Turn Over]

B5.

- a) In your own words, explain the difference between triggers and stored procedures. Discuss at least **three** key differences, including their purposes and how they are executed.

(6 marks)

- b) You are the database administrator for a hospital management system that maintains critical patient information, including medical records, appointment schedules and billing information. One evening, a sudden power failure caused the air conditioner to fail and the database server to overheat, leading to permanent disk failure. Fortunately, the hospital has a daily backup strategy in place, but you need to ensure minimal data loss and downtime.

- i. Describe the steps you would take to recover the database after the power failure. Include specific details about restoring backups and any additional actions needed to ensure data integrity.

(15 marks)

- ii. Explain the concept of full recovery as a database recovery method. Explain what is involved and provide a scenario in which you might use it.

(4 marks)

END OF EXAMINATION