



UNIVERSITI
TEKNOLOGI
PETRONAS

FINAL EXAMINATION MAY 2024 SEMESTER

COURSE : TEB2123 - ADVANCE DATABASE
DATE : 30 JULY 2024 (TUESDAY)
TIME : 9:00 AM - 12:00 NOON (3 HOURS)

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

Note :

- i. There are **SIX (6)** pages in this Question Booklet including the cover page
- ii. **DOUBLE-SIDED** Question Booklet.

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1. a. Prior to the advent of the relational database management systems, a variety of data management systems have been used in the past.

i. Discuss **THREE (3)** types of early database management systems appeared prior to the advent of relational databases.

[6 marks]

ii. Show **ONE (1)** advantage and **ONE (1)** disadvantage for each of the early database management systems in **part (a)(i)**.

[6 marks]

- b. With regard to NoSQL databases,

i. Show **FOUR (4)** motivating factors for database designers and other Information Technology professionals to develop and use NoSQL databases.

[4 marks]

ii. List **FOUR (4)** major types of NoSQL databases.

[4 marks]

2. a. Eventual consistency is an important aspect of NoSQL databases.

i. Discuss in detail the concept of eventual consistency.

[4 marks]

ii. List **THREE (3)** types of eventual consistency used in NoSQL databases.

[6 marks]

b. NoSQL databases are often deployed using clusters of servers. To maintain the consistency of the database across all server, NoSQL databases use the two-phase commitment protocol.

i. Demonstrate using diagrams the working concept of the two-phase commitment protocol.

[6 marks]

ii. Justify, with examples why maintaining consistency in NoSQL database affects its availability.

[4 marks]

3. a. Key-value databases are built based on the concept of associative arrays.
- i. Differentiate between associative arrays. [4 marks]
 - ii. Explain the concept of caches and show how they are related to associative arrays. [6 marks]
- b. Discuss **TWO (2)** of the architecture terms that are frequently used in key-value database architectures. [6 marks]
- c. Justify why are Key-value databases are considered simple and flexible. [4 marks]

4. a. Explain **TWO (2)** modeling terms used in key-value databases.

[4 marks]

- b. Consider the account database schema given in **FIGURE Q2**.

Persons		
ID	FIRST_NAME	LAST_NAME
0	Steven	Edouard
1	Sam	BrightWood

Accounts				
ID	ACCOUNT_TYPE	ACCOUNT_BALANCE	CURRENCY	HOLDER (FK: Persons)
0	Investment	80000.00	USD	0
1	Savings	70400.00	USD	0
2	Checking	4500.00	RM	1
3	Investment	4500.00	RM	1

FIGURE Q4: ACCOUNT DATABASE SCHEMA

- i. Convert the schema into key-value database format.

[10 marks]

- ii. Using REDIS commands create **ANY THREE (3)** keys from the converted schema in **part (b)(i)**:

[6 marks]

5. a. Document databases are one of the major types of NoSQL databases.

i. Define a document with respect to document databases.

[2 marks]

ii. Explain **THREE (3)** syntax rules for JSON objects.

[6 marks]

b. Create a sample document for a shopping cart in an ecommerce website with the following attributes: `user_id`, `cart_id`, `item`, `count`, `price`.

[NOTE: Use the JSON format]

[6 marks]

c. Assume a book database collection referred to as `db.books` is created in MongoDB with the associated information shown in **FIGURE Q5**.

Books will have fields with information about:

- Author name
- Publisher
- Year of publication
- Page count

FIGURE Q5: BOOK DATABASE COLLECTION

i. Create a command to insert a new book to the collection.

[2 marks]

ii. Create a command to remove books by "Isaac Asimov".

[2 marks]

iii. Create a command to retrieve all books with quantity greater than or equal to 20.

[2 marks]

- END OF PAPER -