UNIVERSITY OF FORT HARE

IFS215 & IFS215E

DATABASES

JUNE 2023

Time: 3 Hours **Marks: 120**

This paper consists of SIX (6) pages including the cover page

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GENERAL INSTRUCTIONS TO CANDIDATES

1. This paper consists of **four (4)** *SECTIONS.*
   a. Answer **TWO** questions in SECTION A. Only the first two questions will be marked.
   b. Answer **ALL** the questions in SECTION B.
   c. Answer **ALL** the questions in SECTION C.
   d. Answer **TWO** questions in SECTION D. ***Answer in a new answer book.***

2. Questions can be answered in any order but must be numbered correctly. Any answers you do not want marked must be clearly cancelled.

3. Time management is very important. The value of the mark for each question should be used as a rough guide to the amount of time allocated to answer the question. (120 marks in 180 minutes)

4. It is in the candidate's interest to write neatly.

5. At the end of the examination place all answer books inside the first answer book used.

6. Pencil may be used for the modelling questions.

SECTION A [ANSWER **TWO** QUESTIONS FROM THIS SECTION] = 30 MARKS

Question 1 **[15 marks]**

a. There are nine (9) functions of a database management system. Name and describe five of them. (5)

b. Name and describe the three outcomes of data redundancy. (5)

c. Consider a university registration system. One important business rule for this company might be that *a student can register for a minimum of one modules and a maximum of ten modules, but each module must have a minimum of 20 students enrolled (with an unlimited maximum number)*. Describe and draw this relationship using **UML notation**. (5)

AND/OR

Question 2 **[15 marks]**

a. Describe five characteristics of a relational table. (5)

b. Name and describe the five methods of classifying a database. (5)

c. Consider the PURCHASE and CUSTOMER tables below and provide the relational schema. *[Note you will need to identify a suitable primary key for each table.]* (5)

Purchase table

Transaction ID	Customer ID	Product ID	Purchange date
1112	24221	8977	03-22-2010
1113	24222	8978	03-22-2010
1114	24223	8979	03-22-2010

Customer ID	Customer	Address
24221	Bob	123 East street
24222	Alice	223 Main street
24223	Martha	465 North street

Customer table

Product ID	Name	Price
8977	Banana	.79
8978	TV	400
8979	Watch	50

Product table

AND/OR

Question 3 **[15 marks]**

a. Identify and describe five characteristics of data quality. (5)

b. Describe (with examples) the difference between a *subset*, *complement* and *intersection*. (5)

Use the following to answer (c) and (d):

I = {1;2;3;4;5;6;7;8;9;10}
II = {3;4;5;6}
III = {1;2;3}
IV = {11;12;13}

c. Do II and IV have any common members? Write your answer in the proper notation. (3)

d. If I want to join II and III (make them a union), how would I show this with proper notation? (2)

[TURN OVER THE PAGE FOR NEXT SECTION]

SECTION B [ANSWER **ALL** THE QUESTIONS FROM THIS SECTION] = 30 MARKS

Question 4 **[10 marks]**

Data modelling is the first step in the database design journey, serving as a bridge between real-world objects and the database that resides in the computer.

a. What makes data modelling important? (5)

b. What is a business rule, and what is its purpose in data modelling? (5)

Question 5 **[20 marks]**

Scenario: A library system

Andile has been asked by his boss to draw the Entity Relationship Diagram (ERD) to set up a new database for Library System. He has managed to find some of the information he needs below from interviewing a few people who work for the library. But he knows he is missing information about Primary and Foreign Keys. He is worried as his boss said this is a big client and his job is "on the line".

Andile has collected the following information -

The library has multiple books, each with a unique title and author(s). Each book can have multiple copies, and each copy has a unique ID. The library also has multiple members who can borrow books.

Andile has collected the following entity information:

- Book (with attributes: title and author)
- Copy (with attributes: ID and availability status)
- Member (with attributes: name, email, and phone number)

He also thinks he knows what the relationships are between these entities:

- A book can have multiple copies
- A copy can be borrowed by one member at a time
- A member can borrow multiple copies at different times

Help Andile keep his job by assisting him with creating an ERD using UML notation and indicate all primary and foreign keys.

[TURN OVER THE PAGE FOR NEXT SECTION]

SECTION C [ANSWER **ALL** OF THE QUESTIONS FROM THIS SECTION] = 30 MARKS

Question 6 **[10 marks]**

Having good relational database software is not enough to avoid the data redundancy.

a. Provide a brief definition of normalisation and describe the purpose of normalisation. (5)

b. Describe the process/steps to convert a table to 2NF. (5)

AND

Question 7 **[20 marks]**

Attribute Name	Sample Value	Sample Value	Sample Value	Sample Value	Sample Value
STU_NUM	211343	200128	199876	199876	223456
STU_LNAME	Stephanos	Smith	Jones	Ortiz	McKulski
STU_MAJOR	Accounting	Accounting	Marketing	Marketing	Statistics
DEPT_CODE	ACCT	ACCT	MKTG	MKTG	MATH
DEPT_NAME	Accounting	Accounting	Marketing	Marketing	Mathematics
DEPT_PHONE	4356	4356	4378	4378	3420
COLLEGE_NAME	Business Admin	Business Admin	Business Admin	Business Admin	Arts & Sciences
ADVISOR_LNAME	Grastrand	Grastrand	Gentry	Tillery	Chen
ADVISOR_OFFICE	T201	T201	T228	T356	J331
ADVISOR_BLDG	Torre Building	Torre Building	Torre Building	Torre Building	Jones Building
ADVISOR_PHONE	2115	2115	2123	2159	3209

Using the STUDENT table structure shown above:

a. Write the relational schema. (4)

b. Draw its dependency diagram, and identify all dependencies (including all partial and transitive dependencies). You can assume that the table does not contain repeating groups. (6)

c. Using the answer to (b), remove all partial dependencies, write the relational schema and draw the new dependency diagrams. (6)

d. Identify the normal forms for each table structure you created in (c). (4)

[TURN OVER THE PAGE FOR NEXT SECTION]

ANSWER THIS SECTION IN A NEW BOOK

SECTION D [ANSWER **TWO** QUESTIONS FROM THIS SECTION] = 30 MARKS

Question 8 **[15 marks]**

Study the SQL query below and answer the following questions.

```
SELECT DISTINCT CustomerName, CustomerEmail, CustomerTelephone,
SUM(Quantity * ProductsPrice) as Total_spent
FROM Orders
JOIN Customers USING(Customer_id)
JOIN Order_items USING(Order_id)
JOIN Products USING(Product_id)
WHERE Order_date = '2023-05-15' AND Order_date < '2023-05-16'
GROUP BY Customer_id, CustomerName, CustomerEmail
ORDER BY total_spent DESC.
```

a. Identify the table(s) that will be joined in this query. (4)

b. Explain the purpose of the DISTINCT function in the given SQL statement. (2)

c. State and explain if this query is an example of a data definition or data manipulation language? (2)

d. Explain the purpose of the ORDER BY clause in this SQL query. (2)

e. Identify and list all the attributes from the CUSTOMER table that will be used in this query? (3)

f. How does the ORDER BY clause affect the results of the query shown above? (2)

AND/OR

Question 9 **[15 marks]**

a. How does the UNION operator differ from the JOIN operator in SQL, and when should you use the UNION operator? (2)

b. State and explain two benefits of Stored Procedures in SQL. (2 + 2)

c. What does the acronym DBLC mean, and what does a DBLC portray? (2)

d. Explain the concept of a deadlock in a database system? (2)

e. How can backup and recovery procedures contribute to database security? (3)

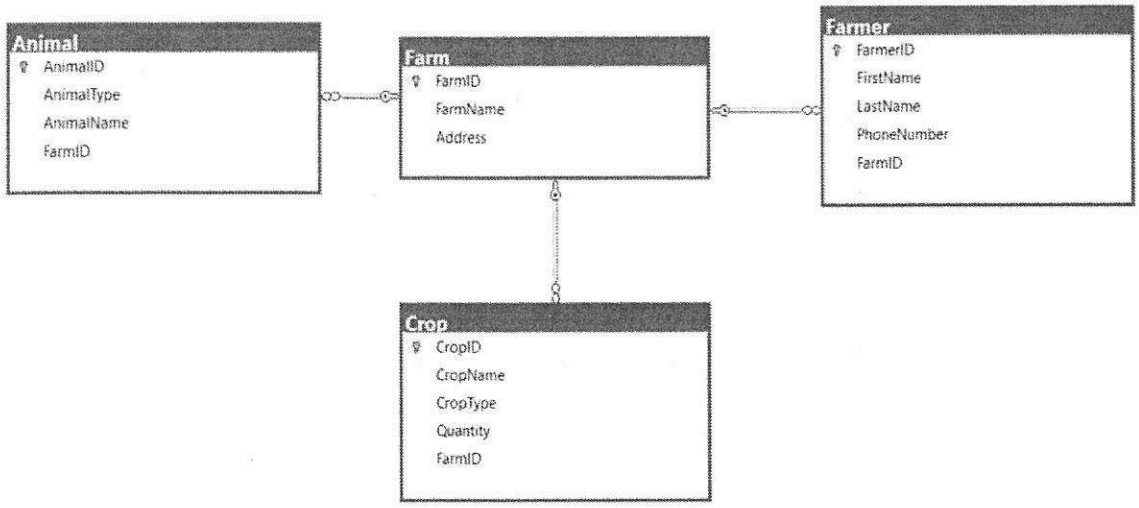
f. Explain the concept of Transaction Isolation in a multi-user database environment. (2)

AND/OR

[TURN OVER THE PAGE FOR NEXT QUESTION]

Question 10 **[15 marks]**

Study the ERD below and answer the following questions.



a. Write the SQL query to create a database named MyFarm_StudentNumber. Replace StudentNumber with your university student number. (2)

b. Write SQL queries to create the Farm Table and the Crop Table from Database Schema shown above. (3 + 4)

c. Write a SQL query that can be used to add a record to the Animal Table based on the Database Schema shown above. (2)

d. Write a SQL query to calculate the sum of the Quantity column from the Crop table and return it as a single row with a column name of TotalCropQuantity. (2)

e. What is the purpose of the foreign key relationship between the Animal and Farm tables? (2)

[END OF PAPER]