



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE

FIRST SEMESTER EXAMINATIONS - 2023

SECOND YEAR BACHELOR OF SCIENCE IN COMPUTER SCIENCE

CS212 – DATABASE I

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES

1. Write your name and student number clearly on the front of the examination booklet.
2. You have 10 minutes to read this paper. You must not begin writing during this time.
3. Section A has **20** multiple choice questions and Section B has **five** questions. You should answer all the questions.
4. All answers must be written in examination booklets only. No other written material will be accepted.
5. Start the answer for each question on a **new** page. Do **not** use red ink.
6. Notes and textbooks are not allowed in the examination room. All mobile phones and electronic/recording devices must be switched off during the examination.
7. Scientific and business calculators are allowed in the examination room.

MARKING SCHEME

Marks are indicated at the beginning of each question. The total is 100 marks.

SECTION A

[1 mark each = 20 Marks]

Choose A or B or C or D from the alternatives given.

1. In a _____ system, the structure of a data file is hardcoded within the application program.
 - A. Database
 - B. File-based
 - C. File server
 - D. Client server

2. In a Client/Server architecture, a _____ client requires considerable resources to run effectively.
 - A. Fat
 - B. Thin
 - C. Server
 - D. 3-tier

3. _____ level is the physical representation of the database on the computer.
 - A. Internal.
 - B. Conceptual.
 - C. External.
 - D. Logical.

4. If set $S = \{a, b, c, d\}$ and set $T = \{b, c, e, f\}$, find $T - S$ (i.e. T minus S).
 - A. $\{b, c\}$
 - B. $\{a, d\}$
 - C. $\{e, f\}$
 - D. $\{a, b, c, d, e, f\}$

5. If the relation schema for the real estate entity is *Property* {PropertyNo, Owner, Address (Lot, Street)}, attribute *Address* is a _____.
 - A. Derived attribute
 - B. Composite attribute
 - C. Multi-valued attribute
 - D. Simple attribute

6. At the end of each semester, Unitech Bookshop would usually conduct a stock-take of its stock inventory for financial reporting. Stock-taking is an example of a_____.
- A. Database instance
 - B. Relation instance
 - C. Database schema
 - D. Relation schema.
7. The two common attributes needed to join multiple relations in a relational database are_____.
- A. Primary key and Foreign key
 - B. Primary key and Secondary key
 - C. Primary key and Composite key
 - D. Foreign key and Secondary key
8. How many different types of entities are involved in a *Recursive* type of relationship?
- A. One.
 - B. Two.
 - C. Three.
 - D. Multiple.
9. Which one of these database tables is the most presentable for the end-users?
- A. View.
 - B. Logical file.
 - C. Join file.
 - D. Base table.
10. A Functional Dependency is a relationship between_____.
- A. Tables and relations
 - B. Entities and relations
 - C. Columns and attributes
 - D. Rows and tuples
11. How many different set of attributes are involved in a Functional dependency that has a transitive relationship?
- A. One.
 - B. Two.
 - C. Three.
 - D. Four.

12. Normalization helps to reduce existence of data redundancy in a database system. Which one of these is not an example of data redundancy?
- A. Obsolete data.
 - B. Refined raw data.
 - C. Data silos (or duplications).
 - D. Outdated legacy data.
13. Which one of these normalized forms is stronger and therefore will suffer less from potential data redundancy?
- A. 2NF.
 - B. 3NF.
 - C. 4NF.
 - D. 5NF.
14. The raw data provided by the end-users for Normalization is usually in the form of _____.
- A. UNF
 - B. 1NF
 - C. 2NF
 - D. 3NF
15. If the domain of an attribute is defined as Numeric (5,2), what is the maximum number of whole numbers can the attribute hold?
- A. Two.
 - B. Three.
 - C. Four.
 - D. Five.
16. The use of keyword LIKE is used in SQL queries to search for characters in text fields. The wild card _____ symbol is used to represent a set of search characters.
- A. %
 - B. &
 - C. \$
 - D. ?

17. Warning or error message is usually coded in the _____ section of the PL/SQL block structure.
- A. Exception
 - B. Executable
 - C. Mandatory
 - D. Declaration
18. *Impedance mismatch* caused by embedded SQL is due to the differences in _____ between SQL and the host program.
- A. ISO standards
 - B. Programming language standards
 - C. DBMS standards
 - D. Operating system standards
19. Which statement about a Cursor is not correct? A cursor _____.
- A. gets opened and closed in the program
 - B. serves as a row pointer
 - C. serves as a temporary table
 - D. displays error messages
20. Procedures and Functions use parameters from calling programs to perform specific tasks. One difference between a Procedure and a Function is that _____.
- A. a procedure returns multiple values while a function returns single value
 - B. a procedure returns single value while a function returns multiple values
 - C. a procedure performs complex tasks while a function performs simple tasks
 - D. both are sub-routines in a program

SECTION B – Short/Long Answer Questions

QUESTION 21.

[5 + 8 + 2 = 15 Marks]

- (a) State one example of an application of a database system in PNG.
- (i) Briefly explain the nature of the operations.
 - (ii) Identify one technical user and explain the function or role of the user.
 - (iii) Identify one non-technical user and explain the function or role of the user.

- (b) Distinguish between the following terms.
- (i) Meta data and enterprise data
 - (ii) DBMS and SQL
 - (iii) View table and base table
 - (iv) Client server and Application server
- (c) Provide two (2) benefits of a 3-tier server architecture over a 2-tier server structure.

QUESTION 22.

[2 + 2 + 2 + 1 + (2 + 3 + 2 + 2) = 16 Marks]

Below is a relational schema showing three (3) entity types which are related to each other.

Project { ProjectNo, Location, Duration, ManagerID }

Employee { EmployeeID, PhoneNo, ManagerID }

Manager { ManagerID, Email (Department, DomainName) }

Explanations on the attributes

Derived attribute: Duration

Multi-valued attribute: PhoneNo

Business rules/constraints

Papua LNG is a major petroleum operation being implemented in the Gulf province. The operation consists of several projects operating in multiple locations within the license area. Managers and employees are employed to work on these projects and complete them within given time frames. The workforce must operate within the rules and constraints set up by the Project management team. The operational policy states that:

- A manager can only manage 1 to 2 projects at any one time.
- The manager is also allocated sufficient resources to manage 10 to 20 employees.
- An employee is assigned to work on one specific project only at the project site.

- (a) Choose one of the relations and identify its *primary* key and *foreign* key attributes.
- (b) Identify a *composite* attribute, and justify.
- (c) The derived attribute *Duration* is calculated from two attribute(s) not shown on the schema. Identify these two attributes and show the formula.
- (d) Justify why *PhoneNo* is a multi-valued attribute.
- (e) Study the business rules/constraints, and construct an ER diagram using Chen's notation. The ER diagram must show:
- (i) Appropriate symbols.
 - (ii) Binary relationships between the three entities.
 - (iii) Attribute types.
 - (iv) Business rules/constraints.

QUESTION 23. [2 + (3+1) + 2 + 4 + (1 + 1 + 2 + 1 + 1) = 16 Marks]

An SME owner uses a simple MS Access database system to manage business transactions. In compliance with tax and audit obligations, the SME obtains its bank statements every month from ANZ Bank and reconciles its ‘cash-in-the-bank’ account in the system. The database table **Bankrec** is maintained in MS Access to perform bank reconciliations. An Admin officer is employed to assist manage the SME’s finance and admin functions. The table below is a sample of **Bankrec** line items for the month of May 2023.

LineNo	Item	Source	Document	Amount
Line5	Consulting	Deposit	Cheque	500
Line3	Rental	Withdraw	Invoice	50
Line4	Shopping	Withdraw	Receipt	70
Line2	Travel	Withdraw	Ticket	550
Line1	Salary	Deposit	PaySlip	1200

- (a) Identify the primary key attribute for *Bankrec*, and justify.
- (b) Construct a single SQL query statement based on the *Bankrec* table.
 - (i) Display all the rows and selected columns *LineNo*, *Document*, *Amount*. Sequence the rows by primary key attribute.
 - (ii) Show the query output.
- (c) Construct an SQL statement that will produce the output below.

LineNo	Item	Amount
Line3	Rental	450
Line2	Travel	550
Line4	Shopping	750

- (d) Study the SQL query statement below, and show its summarized output.

```

SELECT SOURCE, SUM (AMOUNT) AS TOTAL-AMOUNT, COUNT(*) AS
TOTAL-LINES
FROM BANKREC
GROUP BY SOURCE ORDER BY SOURCE
    
```

- (e) A *Trigger* functionality is configured in the system as an extra security intelligence to validate data manipulations. The logic of the trigger (Event-Condition-Action) rule is as follows:

- Based on database table *Bankrec*{*LineNo, Item, Source, Document, Amount*}
- Every reconciled item is monitored to ensure any reconciliation worth K100 and above is reviewed and justified. The Owner receives an email alert if the condition set on the *Amount* field is met.
- The trigger is caused by movements in the tuples, specifically from the *Amount* field getting either inserted from a new tuple or getting updated when an existing tuple is amended.

Identify the following ECA components and briefly explain them.

- (i) What is the event of the rule?
- (ii) State whether the trigger is activated before or after the event?
- (iii) State the condition(s) of the rule?
- (iv) What is the action of the rule?
- (v) Construct a meaningful message for the Owner.

QUESTION 24.

[3 + (2 + 2 + 2) + (3 + 3) = 15 marks]

Below is a *SportsTeam* relation in its first normal form (1NF) with sample records. Study the 1NF table and answer the following questions.

SportsTeam

TeamNo	Suburb	Sponsor	Sponsor-name	Sports	Sports-name
Team1	Taraka	BSP	BSP Bank	NRL	Rugby
Team2	Unitech	BSP	BSP Bank	NRL	Rugby
Team3	Eriku	LB	Lae Biscuit	NSL	Soccer
Team4	Market	SP	SP Brewery	NSL	Soccer
Team5	Town	SP	SP Brewery	NSL	Soccer

- (a) Explain the term “Normalization” and its importance in relational database.
- (b) Explain the following classes of update anomalies.
 - (i) Explain insertion anomaly, and illustrate with an example from *SportsTeam*.
 - (ii) Explain deletion anomaly, and illustrate with an example from *SportsTeam*.
 - (iii) Explain modification anomaly, and illustrate with an example from *SportsTeam*.
- (c) Transform or split the 1NF relation, *SportsTeam* into normalized forms.
 - (i) Create separate tables in their normalized forms.
 - (ii) Show unique tuples for the tables in their normalized forms.

QUESTION 25.

[(1 x 6) + 2 + 2 + 2 + 6 = 18 marks]

The *Department* relation contains three (3) tuples for the three service departments operating at PNG UoT. The sample data shows a 2023 budget allocation for the three departments.

CodeNo	Name	Budget (K)
MAN01	Maintenance services	15,000
MIN01	Minerals processing	12,000
ICT01	ICT services	10,000

Program specification (Background information)

A simple 'Budget Lookup' application is used by the Accounts section to maintain annual budgets for the respective departments; each academic year. The system allows the user (Accounts Officer) to enter the code number, and the system displays the department's allocated budget on the monitor screen with appropriate messages.

The main program logic is designed to call a *Function* to actually lookup the database and return the budget figures back to the main program.

The main program completes the process, then prompts the user for data entry.

Study the pseudo code below and the program specification, and answer the questions.

1. DECLARE *vCode* Department.CodeNo %TYPE
2. DECLARE *vBudget* Department.Budget %TYPE
3. ****Screen prompts to accept data entry****
4. BEGIN
 - CALL Function1
 - CREATE FUNCTION Function1
 - (IN *vCode*)
 - RETURN Numeric
 - BEGIN
 - SELECT Budget
 - FROM Department
 - WHERE *vCode* = CodeNo
 - RETURN Budget
 - END;
4. SET *vBudget* = Budget
5. IF *vBudget* IS NOT NULL THEN
6. Display message
7. ELSE
8. Display message
9. ENDF;
10. END;
11. ****Cycle ends and returns to the start to begin another cycle****

- (a) Refer to the code lines above, and answer these questions.
- (i) What does the input parameter represent?
 - (ii) What does the output parameter represent?
 - (iii) What type of attribute is *CodeNo*?
 - (iv) There are two (2) reasons why the function will return a *NULL*. What are they?
 - (v) What is the purpose of *line3* and *line11*?
- (b) What is the result if the Officer enters code number 'MAN01' and queries the system?
Construct a simple message with the expected result.
- (c) What is the result if the Officer enters code number 'MCS01' and queries the system?
Construct a simple message with the expected result.
- (d) What is the result if the Officer mistyped and inputs 'MIN01', instead of 'MAN01', and queries the system? Construct a simple message with the expected result.
- (e) Construct a simple flow chart diagram corresponding to the logics of the program and the pseudo code outlined above. Ensure that the diagram must
- Show appropriate lines and shapes.
 - Show that the logic flow depicts procedural processing.
 - Have clear and relevant contents.

END OF EXAMINATION