THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE

FIRST SEMESTER EXAMINATIONS - 2022

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.   There are **five** questions, you should answer all 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. If set A = {2, 3, 4, 5, 6} and set B = {1, 2, 3, 4}. Find $A \cap B$ (ie. A intersect with B).
    A. {2, 3, 4}
    B. {1, 2, 3, 4}
    C. {1, 6}
    D. {4}

2. If set A = {1, 2, 3, 4} and set B = {2, 3, 4, 5}. Find A - B (ie. A minus B).
    A. {1}
    B. {5}
    C. {1, 1, 1, 1}
    D. {1, 5}

3. If X contains {11A, Taraka, 2}, and Y contains {11A, 11B, 14B}, which statement is <u>not</u> correct in set theory?
    A. X is a subset of a cartesian product.
    B. X is a tuple, Y is a set.
    C. X contains homogenous elements.
    D. X is a set, Y is a tuple.

4. If the relation schema for table T is T{<u>A</u>, B, C (D, E), F}, what type of attribute is represented by character C in the schema?
    A. Derived attribute.
    B. Composite attribute.
    C. Multi-valued attribute.
    D. Simple attribute.

5. Which is <u>not</u> an example of a database instance? A snapshot of
    A. Inventory at month-end to conduct stock-take
    B. Goods at year-end for clearance sale.
    C. Final assessment results at semester-end.
    D. An image taken at a graduation ceremony.

6. Recursive relationship describes a relationship between
    A. One entity.
    B. Two entities.
    C. Three entities.
    D. Multiple entities.

7. Which type of attribute is suitable for reporting or grouping purposes?
    A. Primary key attribute.
    B. Composite attribute.
    C. Simple attribute.
    D. Multi-valued attribute.

8. Alternate names for table attributes are
    A. Column and Field
    B. Row and Field
    C. Tuple and Row
    D. Row and Column

9. Data Definition Language (DDL) is designed to create database objects
    A. Once.
    B. Twice.
    C. Multiple times.
    D. None of the above.

10. If an attribute is defined as Numeric(5,1), what is the maximum allowable value can it hold?
    A. 5,555.1
    B. 55,555.1
    C. 9,999.9
    D. 99,999.9

11. SQL uses aggregate functions to group and summarize row data for reporting purposes.
    Which of these is not a valid aggregate function?
    A. SUM
    B. AVG
    C. MAX
    D. TALLY

12. Which type of table permits users to access data in a way that is customized to their needs?
    A. View.
    B. Logical file.
    C. Join file.
    D. Base table.

13. Which statement about data redundancy is correct? Data redundancy is <u>not</u> caused by
    A. Null values.
    B. Obsolete data.
    C. Duplicated data.
    D. Cleansed data.

14. Which statement is <u>not</u> correct about a *trigger*, and a *function*? They
    A. Perform validation on database tables.
    B. Perform specific tasks.
    C. Are invoked by certain events and actions.
    D. Operate on the use of called and calling parameters.

15. In which section of the PL/SQL block structure do you define and initialize variables and cursors?
    A. Exception.
    B. Executable.
    C. Mandatory.
    D. Declaration.

16. In which section of the PL/SQL block structure do you use iteration statements?
    A. Exception.
    B. Executable.
    C. Mandatory.
    D. Declaration.

17. A *cursor* in PL/SQL programming uses FETCH INTO keywords to
    A. Open the cursor.
    B. Insert row values into the cursor.
    C. Retrieve row values from the cursor.
    D. Update row values in the cursor.

18. Which statement about a cursor is <u>not</u> correct? A cursor
    A. Must be closed if previously opened in the program.
    B. Serves as a row pointer.
    C. Serves as a temporary table.
    D. Displays error messages.

19. Which statement about ODBC is <u>not</u> correct? *ODBC*
    A. Is a standard API.
    B. Is written in C programming language.
    C. Is a product of Microsoft.
    D. Allows connections between users.

20. The introduction of Digicel into PNG with its affordable services in voice, data, and internet applications has seen a huge spike in the number of users in the ICT sector. Which feature of the application is designed to attract users in general?
    A. Database connectivity
    B. Database design
    C. Graphical user interface
    D. System performance

SECTION B – Short/Long Answer Questions

QUESTION 21.   [3 + 3 + 3 + 3 =12 Marks]

(a) DBMS environment consists of – hardware, software, data, procedures, and people. Choose any three (3) components and briefly explain them.

(b) State three (3) differences and distinguish between a file-based approach and database approach.

(c) The two components of SQL are DDL and DML. State three (3) differences and distinguish between the two SQL languages.

(d) There are three (3) types of servers in a 3-tier server architecture – client, database and application. Differentiate between these three types of servers.

QUESTION 22.   [2 + 2 + 2 + 1 + (2 + 2 + 2 + 2) = 15 marks]

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

> *Room {RoomNo, FloorLevel, SubjectID, StaffID}*
> *Subject {SubjectID, SubjectName (Code, Number)}*
> *Lecturer {StaffID, Department, PhoneNo}*

Explanations on the attributes
Derived attribute – FloorLevel
Multi-valued attribute - PhoneNo

Business rules/constraints
There are certain administrative rules that MCS department has to comply with during the course of a semester every year. The policy states that:
- A lecturer must be allocated between 1 and 2 subjects to teach.
- There are only 5 lecture rooms, so a lecturer can use any one of these 5 rooms to teach the allocated subjects.
- A single room caters for multiple subjects to be taught in.

(a) Which entity contains one or more *foreign* keys? State the entity and the key attributes.

(b) Identify a *composite* attribute, and justify.

(c) Justify why *FloorLevel* is a derived attribute, and which attribute is it derived from? Use practical examples in the MCS department to justify.

(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.   [5 + (2+2) + 2 + 4 + (1 + 1 + 2 + 1 + 1) = 21 marks]

A private Consulting firm offers Training & Consultation services and uses MYOB (business application database) to record all its business transactions. The system uses *Transaction* table to record the transaction details.

The average position (Expenses & Revenue) of the firm's monthly business activities is captured on the *Transaction* table below.

Transaction

ItemNo	Item	Site	Type	Amount
Item5	Stationery	Lae	Expense	150
Item3	Rental	Lae	Expense	50
Item4	Consultation	Lae	Revenue	500
Item2	Training	Lae	Revenue	300
Item1	Travel	POM	Expense	250

(a) List down the attributes of the relation with their data types, and identify its primary key attribute.

(b) Basing on the *Transaction* table above,
   (i) Construct an SQL statement that will show all the rows with the selected columns (*ItemNo, Type, Amount*), and sequenced by its primary key attribute.
   (ii) Show the resulting query output.

(c) Construct a single SQL statement that will produce the query output as shown below.

ItemNo	Item	Site	Type	Amount
Item3	Rental	Lae	Expense	50

(d) Study the SQL query statement below, and show its output if it is to be executed.

*Select Type, COUNT(ItemNo) AS myLine, SUM(Amount) AS myBudget
from Transaction Group By Type Order By Type;*

(e) The firm has a trigger feature setup in MYOB to perform validation on the expenses to control unnecessary spendings. The logic of the trigger (Event-Condition-Action) rule is as follows:
- The trigger rule is based on the database table, *Transaction* whose attributes are {ItemNo, Item, Site, Type, Amount}
- Every expenditure transaction is monitored to ensure any transaction exceeding K200 is reviewed and approved. The manager receives an email alert if the *Amount* field exceeds K200.
- The value of the *Amount* field is inserted from a new tuple **or** updated when an existing tuple is revised.

Identify the following trigger components and briefly explain them.
  (i) What is the <u>event</u> in relation to the *Transaction* table?
  (ii) State whether the trigger will activate <u>before</u> or <u>after</u> the event?
  (iii) What is/are the <u>condition(s)</u> of the trigger?
  (iv) What type of <u>action</u> will be taken?
  (v) Construct a meaningful message for the manager.

QUESTION 24.   **[2 + (2 + 2 + 2) + (3 + 3) = 14 marks]**

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

Vehicle

VehicleID	Description	Dealer	Dealer-name	Make	Make-name
ZSU1	Truck	BM	Boroko Motors	NIS	Nissan
ZSU2	Sedan	BM	Boroko Motors	NIS	Nissan
ZSU3	Wagon	BM	Boroko Motors	NIS	Nissan
ZSU4	Trooper	BM	Boroko Motors	TOY	Toyota
ZSU5	Bus	Ela	Ela Motors	SUZ	Suzuki

(a) Explain the term "normalization" and its importance in relational database theory.

(b) Explain the following classes of update anomalies. Use examples from *Vehicle* relation in your explanations.
   (i)   Insertion anomaly.
   (ii) Deletion anomaly.
   (iii) Modification anomaly.

(c) Transform or split the 1NF relation (Vehicle) into normalized forms.
   (i) Create separate master tables.
   (ii) Show unique tuples for the master tables.

QUESTION 25.   **[(1 x 8) + (2 + 2) + 2 + 2 + 2 = 18 marks]**

The *PMV* relation below is a sample from a Local Tour guide firm.

PMV

RouteNo	Destination	Fare (Kina amount)
R100	Lae-Madang	100
R11A	Lae-Ramu	50
R102	Lae-K92	30

Program specification
A simple 'PMV Lookup' online application is operated by the firm to assist tourists plan and budget for their travels. The system allows the user (tourist) to enter the route number, and the system displays the matching data on *Destination* and *Fare* on the screen.
The main program of the system is designed to call two separate *functions* in sequence, *Function1* and *Function2*. When invoked, the functions perform their specific tasks separately and the combined results are displayed on the screen with the appropriate messages. If there is no matching record, an appropriate message is also displayed to advise the user accordingly.

Below is the pseudo code of the main program logic and *Function1* using PL/SQL.

```
1. DECLARE vRoute PMV.RouteNo %TYPE
2. DECLARE vFare PMV.Fare %TYPE
3. CALL Function1
          CREATE FUNCTION Function1
          (IN vRoute)
          RETURNS Numeric
          BEGIN
              SELECT PMV.Fare
              FROM PMV
              WHERE vRoute = PMV.RouteNo
              RETURN (PMV.Fare)
          END;
4.  SET vFare = Function1 (vRoute);
5.  CALL Function2
6.  IF vFare IS NOT NULL THEN
         display relevant message
         ELSE
         display relevant message
     ENDIF;
```

Study the information (*program specification, PL/SQL code*) provided above, and answer the following questions.

(a) Provide the answers to the eight (8) questions below on your answer booklet.

Question	Answer
(i) What is the name of the input variable?	
(ii) What is the name of the database table attribute that is similar to the input variable?	
(iii) What is the data type of the input variable?	
(iv) What is the name of the output variable?	
(v) What is the name of the database table attribute that is similar to the output variable?	
(vi) What is the Data type of the output variable?	
(vii) What type of attribute is RouteNo in *PMV*?	
(viii) What does *IS NOT NULL* mean in Function1?	

(b) If a tourist enters route number 'R11C' and queries the system, what is the feedback or result?

(c) If a tourist enters route number 'R101' and queries the system, what is the feedback or result?

(d) If a tourist mistyped and enters route number 'R102' instead of 'R101', what is the feedback or result?

(e) Assume *Function2* is coded similar to *Function1*.
   (i) What is the specific task performed by Function2?
   (ii) State two (2) differences you would expect to see in the code lines between Function1 and Function2?

<div align="center">

END OF EXAMINATION

</div>