



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE

FIRST SEMESTER EXAMINATIONS - 2022

THIRD YEAR BACHELOR OF SCIENCE IN COMPUTER SCIENCE

## CS312 – DATABASE II

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. Suppose superclass PERSON has subclasses {STUDENT, STAFF}. Which statement is correct concerning superclass/subclass in a 1:1 relationship?
  - A. A Student is a Person
  - B. A Staff is a Student
  - C. A Student is a Staff
  - D. A Person is a Staff
  
2. The Snax products sold in the Union shop are a product of Lae Biscuit Company. Given the scenario, which statement about the Entity classes is not correct?
  - A. Packaged\_item and sold\_item are subclasses
  - B. Product is the superclass
  - C. The subclasses are disjoint
  - D. The subclasses are non-disjoint
  
3. If the entities {ENGINEER, SCIENTIST} are WORKERS, and TRAINEE is a subset of WORKER. Which statement is not correct?
  - A. Engineer is a subclass
  - B. Trainee is a subclass of the UNION of the two entity sets of Engineer and Scientist
  - C. Trainee is a generalization of Engineer and Scientist
  - D. Worker is a generalization of Engineer and Scientist
  
4. The snapshot of the MCS student record '*as at end of week13*' are 20 in Year4, 25 in Year3, 30 in Year2 and 35 in Year1. The snapshot is technically referred to as
  - A. Instant reporting
  - B. Instances of a specialization
  - C. Relationship occurrences
  - D. Department quota
  
5. Which of the Normal forms is based on functional dependencies that take into account all candidate keys in a relation, and where every determinant is a candidate key?
  - A. First Normal Form (1NF)
  - B. Second Normal Form (2NF)
  - C. Third Normal Form (3NF)
  - D. Boyce–Codd Normal Form (BCNF)

6. If a relation is free from *transitive dependency* situation, is said to be in its
- A. First Normal Form (1NF)
  - B. Second Normal Form (2NF)
  - C. Third Normal Form (3NF)
  - D. Boyce–Codd Normal Form (BCNF)

**Use the following information to answer Question 7 and 8**

A database relation T has a relation schema as  $T \{\underline{A}, \underline{B}, C, D\}$ , with its primary key underlined, and its three (3) functional dependencies are defined as:

- $\{A, B\} \rightarrow C, D$
- $\{B, C\} \rightarrow D$
- $\{A, C\} \rightarrow D$

7. Which statement about the candidate key is not correct?
- A.  $\{A, B\}$  is the primary key
  - B.  $\{B, C\}$  is the candidate key
  - C.  $\{C, D\}$  is the candidate key
  - D.  $\{A, C\}$  is the candidate key
8. Which statement about the functional dependency is not correct?
- A. C is fully dependent on  $\{A, B\}$
  - B. D is fully dependent on  $\{A, B\}$
  - C. D is partially dependent on  $\{B, C\}$
  - D. D is fully dependent on  $\{A, C\}$
9. Which statement describes the difference between *SQL join* and *SQL sub-query*? They both
- A. Query multiple tables
  - B. Use complex SQL query statements
  - C. Have the same impact on system performance
  - D. Achieve the same result output
10. Given elements of  $X = \{9, 2, A, 0\}$  and elements of  $Y = \{4, 5, A, 0\}$ . The output from executing the SQL sub-query “(Select \* from X) *EXCEPT* (select \* from Y)” will result in
- A.  $\{9, 2\}$
  - B.  $\{9, 2, 0\}$
  - C.  $\{4, 5\}$
  - D.  $\{A, 0\}$

11. If an SQL statement is constructed with three (3) tables for the purpose of self-joining, how many physical tables are involved in the operation?
- A. 1
  - B. 2
  - C. 3
  - D. 4
12. When a host program requires relational data, it must request the data using SQL. The *impedance mismatch* that exists between SQL and the host program language is based on the differences in the
- A. End-user requirements
  - B. Interfacing techniques
  - C. Date formats
  - D. Programming Languages
13. Database Administration is a highly technical function of any organizations, managed by the domain experts in Database systems. The underlying objective of the Database Administration role is focused on managing the organization's
- A. Users
  - B. Systems
  - C. Data
  - D. Investment
14. Application systems (and DBMS) are usually configured during installation and upgrades, through the use of system parameters to control how it functions. The system parameters are also known as
- A. Major program flags
  - B. Major sub-routine flags
  - C. Major sub-programs flags
  - D. Major function flags
15. In the '*Implementation & loading*' phase of Database Life Cycle, the Designers 'create database' in the DBMS. Which is not the outcome of the '*create database*' activity?
- A. Database tables and attributes
  - B. Data libraries
  - C. Table indexes and key constraints
  - D. None of the above

16. After the database has been created, the data must be loaded from legacy systems into the new environment. What is the appropriate term that describes the '*data loading*' process?
- A. Data movement
  - B. Data migration
  - C. Data connectivity
  - D. Data copying
17. Database design in large organizations involves both DBMS and the Application system to be designed in parallel. The activity that involves the design of the data content, structure and constraints of the database is a
- A. Process-driven design
  - B. Object-driven design
  - C. Data-driven design
  - D. System-driven design
18. When an SQL statement is executed, the DBMS issues "a set of instructions" to access the required data from the database. What is this set of instructions called?
- A. Data routes
  - B. Data access paths
  - C. Data road maps
  - D. Data instructions
19. Which statement about ODBC (Open Database Connectivity) is not correct? *ODBC*
- A. Is a standard API (Application Programming Interface)
  - 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. If you want to develop an app for PNG users, which feature is the most critical to factor in the designs to attract users who are mostly non IT technical people?
- A. Internet connectivity
  - B. Database design
  - C. Graphical user interface
  - D. System performance

**SECTION B – Short Answer Questions**

**QUESTION 21.** [ (4 + 3 + 2 + ) + 3 + (3 + 3 + 3) = 21 marks ]

The two entities *Student* and *Staff* are physical entities that exist here at UoT.

- (a) Attach some attributes to the two entities and construct a simple ER-diagram (ERD) using Chen notation. The ERD should reflect the following:
  - i. Appropriate attributes
  - ii. Both entities should have these attribute types – Primary key, Derived, Composite
  - iii. Appropriate relationship between them
  
- (b) Explain one practical constraint (or business rule) on their relationship. Use the diagram in (a) above or construct a separate ERD, and show this constraint.
  
- (c) The following concepts are part of the EER modeling techniques. Provide brief explanations and distinguish between the two terms. Illustrate using your ER diagrams from (a) above.
  - i. Super-class and Subclass
  - ii. Specialization and Generalization
  - iii. Disjoint and Non-disjoint

**QUESTION 22.** [ (4 + 2 + 2) + 2 + (2 + 2 + 2 + 1) = 17 marks ]

Task A: The relation *CustomerProductUOM* is in 1NF and needs to be further normalized into BCNF relations.

CustomerProductUOM							
ProdNo	Prod-name	UOM	UOM-name	CustNo	Cust-name	FactoryID	Factory-site
Prod1	Coffee	CT	Carton	MIN	Mining	F11	Taraka
Prod2	Coke	BX	Box	LIB	Library	F10	Town
Prod3	Milk	BX	Box	MIN	Mining	F11	Taraka
Prod4	Milo	CT	Carton	MIN	Mining	F11	Taraka
Prod5	Sugar	EA	Each	LIB	Library	F11	Taraka

- a) Identify the four (4) normal tables from the ‘*CustomerProductUOM*’ relation. Show these tables and ensure each table reflects the following:
  - i. Correct table names and attributes
  - ii. Unique tuples from the initial 1NF
  - iii. Primary and Foreign key attributes
  
- b) Use the Primary/Foreign key mechanism and draw a diagram showing the relationship between the tables.

**Task B:** Apply *de-normalization* through SQL table joins and recreate 1NF relation in its customized version as shown below.

Custom report		
ProdNo	UOM	FactoryID
Prod2	BX	F10

- c) Construct an SQL JOIN statement that corresponds to the customized report. Use the SQL syntax provided below and replace the underlines with the correct:
- Selected attributes from the tables
  - Table names
  - Common attributes
  - Table attribute and the value for the *WHERE* portion of the statement

*Syntax to join 4 tables*

```

SELECT selected attributes
FROM ((t1 INNER JOIN t2 ON t1.attribute = t2.attribute)
INNER JOIN t3 ON t3.attribute = t1.attribute or t2.attribute)
INNER JOIN t4 ON t4.attribute = t1.attribute or t2.attribute or t3.attribute
WHERE table.attribute = value

```

*(Note: You may use attribute names only rather than the full table.attribute combination in your SQL.)*

**QUESTION 23.** [ (4 + 2 + 2) + (3 + 3 + 3) + 2 = 19 marks ]

- (a) SQL uses *JOIN* operations (Inner, Left, Right, Left) to compute complex sub-queries on multiple rows and tables.  
 Suppose elements in *TableA* = {1, 3, A}, and elements in *TableB* = {A, B, 4}.
- Explain each type of JOIN operation
  - Use TableA, TableB and their elements to illustrate your explanations
  - Also provide the actual query results if you execute the JOINS on TableA and TableB
- (b) SQL uses *SET* operations (*Union, Intersect, Except*) to compute complex sub-queries on multiple rows and tables.  
 Suppose elements in *TableX* = {A, B, 3}, and elements in *TableY* = {1, 2, 3}.
- Explain each type of SET operation.
  - Use TableX, TableY and their elements to illustrate your explanations.
  - Also provide the actual query results if you execute the SET operations on TableX and TableY.
- (c) From the results in (a) and (b), which JOIN/SET pair operations can be used interchangeably to achieve the same query results?

**QUESTION 24.**

**[ (2+2+2) + 3 + (3 + 3 + 4 + 2 + 2) = 23 marks]**

(a) The main tasks related to Database Administration (DBA) are – *database design, data security and privacy, backup and recovery, user support and training, policies and documentation.*

- i. Explain in your own words the concept of Database Administration. What is its overall significance to the business Enterprise?
- ii. Select one (1) specific task and provide brief explanation.
- iii. How does this specific task contribute to the overall function of DBA?

(b) In your last two assignment tasks, you worked on six different phases of a typical Database Life Cycle (DBLC).

Operation	Implementation and loading	Maintenance & Evolution
Testing and Evaluation	Database initial study	Database design

- i. Draw a simple diagram to illustrate the DBLC. Label the diagram with the correct phases in their respective sequence.

(c) Choose one specific phase in (b) above and answer the questions.

- i. State two (2) key stakeholders (or people), and briefly explain their roles & responsibilities
- ii. Some design defects may arise if some actions or activities are not adequately addressed in this phase. State one (1) possible issue or problem and provide brief explanation.
- iii. State two (2) actions or activities that are carried out in this phase, and briefly explain them
- iv. State two (2) input requirements for this phase
- v. State two (2) output requirements (or expected outcome) from this phase

**END OF EXAMINATION**