



The University of Fiji
(An Entity of Arya Pratinidhi Sabha of Fiji)



SCHOOL OF SCIENCE AND TECHNOLOGY
Semester 2, 2025

FINAL EXAMINATION PAPER

ITC104: DATABASE SYSTEMS

Important Instructions to Students:

1. Read the questions, instructions carefully and answer the questions.
2. You are allowed an **extra 10 minutes reading time** (during this time, you are not allowed to write with pen) and **180 minutes (3 Hours) to complete this paper**.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask from the supervisor. Write your name, course code and student identification number in the answer booklet and in the attendance sheet.
5. This paper contains three (3) sections A, B and C. All questions are compulsory to answer.
6. Write all your answers legibly. The marker has the right to award zero for answers that are not legible.
7. This is a **Closed Book Examination**. The University views plagiarism, cheating and dishonest practice as serious offences and if found, offenders are penalized.

Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-30	Multiple Choice	30	54 minutes
B	1-8	Open Ended Questions	20	36 minutes
C	1-5	Case Scenario Questions	50	90 minutes
		TOTAL	100	180 Minutes

SECTION A**MULTIPLE CHOICE QUESTIONS****30 MARKS**

Write the question number and the letter which represents the **most** appropriate answer for each question in the answer booklet.

1. When re-evaluating the current ERD design, what is the best possible action a database designer can take to improve the current design in order to account for new operational processes in the company?
 - a. Review the designated private and foreign keys
 - b. Review the connectivity lines and symbols
 - c. Review previous design documentation
 - d. Review the relationship text between entities
2. If processing speed was an important requirement for a company when building out a database, what changes can a designer revise in the next database iteration if the current design has more than 95% of tables with a 1:1 relationship?
 - a. Combine some tables together.
 - b. Create more 1:M relationships.
 - c. Create more M:N relationship.
 - d. Leave the database design as is.
3. A large entity relationship model (ERM) diagram was presented to management but the relationships between each entity was hard to understand visually, especially with dashed lines. If using the Crow's Foot model to depict the relationships, what other actions could be done to the ERM to make it more understandable in terms of number of occurrences in the related entities?
 - a. Notate the cardinality next to each table.
 - b. Set the primary keys to a bold font.
 - c. Label the foreign keys as "FK."
 - d. Draw solid lines between each entity.
4. When configuring a relational database to show that a PROFESSOR can teach multiple CLASSES, and that a CLASS can have only one PROFESSOR, a simple line is not enough for design reviewers to understand the full relationship on the diagram. What else would make it easier for the reviewer to understand their relationship?
 - a. Relationship strength
 - b. Entity name
 - c. Attribute constraints
 - d. Connectivity classification
5. In a relationship between COURSE and CLASS, COURSE has attributes CRS_CODE, DEPT_CODE, and CSR_DESCRIPTION, and CLASS has CRS_CODE, CLASS_SECTION, CLASS_TIME, and ROOM_CODE. Which attribute would be an example of a foreign key?
 - a. CLASS_SECTION
 - b. DEPT_CODE
 - c. CRS_CODE
 - d. ROOM_CODE

6. A new department is created in a company. To keep track of the projects department, a new table is required. Given the size of the company there are a large number of tables and attributes. To avoid potential confusion, and to make sure to refer to the adequate foreign keys, which strategy is more adequate?
- Avoid foreign keys, to prevent searching for existing attribute names.
 - Use a large prefix in the names of attributes to avoid possible homonyms.
 - Query the data dictionary to get the necessary information.
 - Use relational algebra to test if all chosen names are correct.
7. Relations are a _____ construct, thus it's easier for users to think in terms of tables.
- metaphysical
 - mathematical
 - hardware
 - physical
8. After looking at the database design, another designer found that the primary keys were not established with a simple underline. Knowing that single-valued attribute can almost always be labeled as primary identities, which of the following attributes would be a good candidate as a primary key for a table?
- SS_NUMBER
 - COLLEGE_DEGREE
 - CAR_COLOR
 - CAR_PART
9. In the relationship where "PROFESSOR teaches CLASS," and a class can have only one professor teaching, how is the PROFESSOR cardinality notated if PROFESSOR is mandatory?
- (0,N)
 - (1,1)
 - (1,N)
 - (0,1)
10. While a database analyst is analyzing data, they find different versions of the same data appearing in different places? What do you call this type of situation?
- Data inconsistency
 - Poor data security
 - Structural dependence
 - Conceptual dependence
11. Using attributes such as STU_LNAME and STU_FNAME, the entity STUDENT would be represented with a _____ in the Chen model.
- square
 - circle
 - triangle
 - rectangle

12. What name has the set of permissible values of a column or attribute?
- Domain
 - Range
 - Extension
 - Type
13. When working in an ER model, what does each row in the relational table represent?
- attribute
 - entity
 - schema
 - relationships
14. Software vendors appreciate a database model that is implementation oriented. If a conceptual design is not ideal, what characteristics of a good model would be better than a web of ideas type of layout.
- A compact table with associated entity and attributes.
 - A large circle with connected entities.
 - A dashed line connecting multiple attributes.
 - A linear workflow from start to finish.
15. A database designer set the CRS_CODE attribute as the primary key to the CLASS table. If no other changes are made, how many composite identifiers does the table have?
- Zero
 - One
 - Two
 - Three
16. In a PROFESSOR and COURSE relationship if the PROFESSOR object is given a cardinality of (1,1), then which of the following would be a true statement about the university?
- a PROFESSOR must have more than one COURSE to teach
 - a PROFESSOR can optionally teach a COURSE
 - a COURSE must have at least one PROFESSOR to teach
 - a COURSE can optionally have a PROFESSOR to teach
17. In an entity relationship diagram with objects EMPLOYEE, DEPENDENT, CUSTOMER and PRODUCT, which of the following would be the most appropriate example of a derived entity?
- EMPLOYEE
 - DEPENDENT
 - CUSTOMER
 - PRODUCT
18. A workgroup database is a _____ database.
- single-user
 - multiuser
 - desktop
 - distributed

19. Which of the following is true of business rules?
- They allow the designer to set company policies with regard to data.
 - They allow the designer to develop business processes.
 - They can serve as a communication tool between the users and designers.
 - They provide a framework for the company's self-actualization.
20. _____, also known as RESTRICT, yields values for all rows found in a table that satisfy a given condition.
- INTERSECT
 - UNION
 - DIFFERENCE
 - SELECT
21. Which of the following refers to the situation where different versions of the same data are stored at different places because they were not updated consistently?
- Data query
 - Data integrity
 - Data dictionary
 - Data redundancy
22. Character data, also known as ____ data, can contain any character or symbol not intended for mathematical manipulation.
- unsigned integer
 - signed integer
 - string
 - content
23. In a M:N relationship between STUDENT and CLASS at a university, it is possible that a class may start with no students and a student may start with no classes. If a database designer is using the O symbol using the Chen model, what is the designer hoping to establish between these entities?
- An optional relationship.
 - A cardinality figure.
 - A domain of possible values.
 - A set of optional identifiers.
24. When reading the database diagram with entities, management has a hard time understanding the implementation of these tables with just solid lines. Their relationships are still questionable. Using the tables ROOM and BUILDING, what is the most appropriate way a database designer can conceptualize their implementation in the diagram?
- Insert the phrase "located in" in between
 - Insert the phrase "many in" in between
 - Insert the phrase "one in many" in between
 - Insert the phrase "connected to" in between

25. A table of products with a foreign key of vend_code references to the table vendor. Which of the following could be an unintended effect of deleting an entry in the vendor table?
- It has an effect only on the vendor table.
 - It creates a reference to a null entry.
 - It damages the entity's integrity.
 - It damages the referential integrity.
26. In some cases where an association is maintained within a single entity, a database designer should depict with a line on itself. If a manager is able to manage other employees, how would the EMPLOYEE table's relationship degree be described as?
- unary
 - binary
 - ternary
 - higher-order
27. Although not required to capture, the EMPLOYEE table can have duplicates with the attributes EMPLOYEE_NUM and EMP_SPOUSE when employees marry each other. How would the database be designed better?
- Keep the database as is.
 - Place the EMP_SPOUSE was on a different table.
 - Using a bridged entity.
 - Removing the EMP_SPOUSE attribute.
28. Zoe needs an open-source, distributed framework to provide an environment for high speed, parallel computation and storage using low-cost hardware as nodes in order to process Big Data. Which of the following would Zoe use?
- XML
 - NoSQL
 - Hadoop
 - MapReduce
29. In a student's table of a large university the name attribute could be used as a _____.
- primary key
 - foreign key
 - secondary key
 - candidate key
30. If CUSTOMER and INVOICE is classified as a 1:M and one direction would specify that a CUSTOMER may generate many INVOICES, what would be true of the opposite direction?
- CUSTOMER is unique to many INVOICES
 - Each INVOICE is generated by one CUSTOMER
 - Each INVOICE is written to many CUSTOMERs
 - CUSTOMERs are given INVOICES

SECTION B**OPEN - ENDED QUESTIONS****20 MARKS**

Answer ALL the questions from this section in the answer booklet provided. Write your answers in the answer booklet clearly and in detail

- 1) A retail company is expanding its operations online and plans to develop a new customer database. Before implementation, the database team studies the company's situation by defining business problems, objectives, constraints, and scope, then moves on to designing a conceptual schema with entities such as customers, orders, and payments. Explain how the Database Life Cycle (DBLC) guides this process and discuss why the initial study and conceptual design stages are important, including possible negative outcomes if these steps are ignored. (3 marks)
- 2) A university plans to replace its outdated student information system. During the initial review, the project team conducts interviews with staff and students to gather requirements, evaluates the limitations of the old system, and drafts a logical system design. Based on the Systems Development Life Cycle (SDLC), identify which phase this scenario represents and discuss why it is critical for project success, including the risks of rushing or skipping this phase. (3 marks)
- 3) What does it mean when we say that a database enforces both entity integrity and referential integrity? (2 marks)

Two tables in database CampusSnacks are given below. Use these tables and answer question 4 (a-c).

Table: STALL

PRODUCT	PRICE
Chips	1.50
Juice	2.00
Energy Bar	2.50

Table: KIOSK

PRODUCT	PRICE
Chips	1.25
Chocolate Bar	1.20
Energy Bar	2.50

- 4) Draw the tables that will result from applying the following relational operator to the STALL and KIOSK tables shown in above. (3 marks)
 - a. UNION of STALL and KIOSK
 - b. INTERSECT of STALL and KIOSK
 - c. KIOSK DIFFERENCE STALL

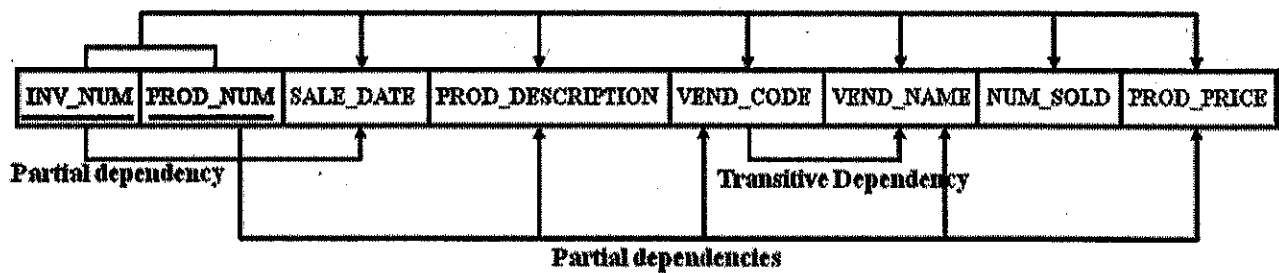


Figure 1: Dependency Diagram

- 5) Figure 1 above shows a dependency diagram with partial and transitive dependencies. Use Figure 1 to answer questions (a-b).
 - a) Remove all partial dependencies, write the new relational schema, and draw the corresponding dependency diagrams. Clearly identify the normal form (NF) for each table you create. *(2 marks)*
 - b) Remove all transitive dependencies, write the updated relational schema, and draw the new dependency diagrams. Again, state the normal form (NF) of each table you create. *(2 marks)*
- 6) What's the difference between a composite key and a composite attribute? Use example to explain. *(2 marks)*
- 7) Explain multivalued attributes with the help of examples. How are multivalued attributes indicated in the Chen Entity Relationship model? *(2 marks)*
- 8) What is a key and how is it important in a relational model? *(1 mark)*

Answer ALL the questions from this section in the answer booklet provided. Write your answers in the answer booklet clearly and in detail

The UniFit Fitness Center manages members, instructors, and group classes (e.g., Yoga, Zumba, HIIT). Key facts:

- The center has Members. Each member has a unique MemberID, full name, mobile, email (unique), gender, date joined, and MembershipType (e.g., Basic, Premium).
- MembershipType determines monthly Fee and AccessLevel (e.g., "Gym Only", "Gym + Classes").
- The center employs Instructors who lead classes. Each instructor has a unique InstructorID, full name, specialty (e.g., Yoga), and phone.
- The center offers Classes. Each class has a unique ClassID, ClassName, default Capacity, and is assigned to one lead Instructor.
- Classes run on a repeating schedule (e.g., Mondays 6–7 pm). To track enrollments historically, Registrations record which members join which classes and when. A member can register for many classes; a class can have many members.
- Each registration tracks RegistrationDate and a Status (e.g., active, cancelled).
- Business rules:
 - A member's email must be unique.
 - A class cannot register more members than its capacity.
 - RegistrationDate cannot be before the Member's JoinDate.
 - Status defaults to 'ACTIVE'.

Q1. Conceptual Design – Crow's Foot ERD (12 marks)

Using the above case, draw a Crow's Foot ERD that models the UniFit Fitness Center database. Your ERD must:

- Show the following entities with their attributes:
 - Member
 - MembershipType
 - Instructor
 - Class
 - Registration
- Clearly mark primary keys (PK) and foreign keys (FK) where appropriate.
- Show and label all relationships.
- Show correct cardinalities in Crow's Foot notation.
- Make sure to break any M:N relationships with the help of a bridging entity into 1:M
- Indicate all the business rules in your diagram.

Q2. Physical Design – Create Tables Data Definition Language (DDL) (16 marks)

Using the entities identified in Q1, write the SQL CREATE TABLE statements for the following five entities: Member, MembershipType, Instructor, Class, and Registration.

When writing your DDL:

- a) Use INTEGER for numeric IDs (with auto-increment or generated).
- b) Use VARCHAR or CHAR for all text attributes.
- c) Include PRIMARY KEY (PK) and FOREIGN KEY (FK) constraints as appropriate.
- d) Apply NOT NULL where required.
- e) Ensure the following rules are enforced:
 - Member
 - MemberID is the PK, auto-incremented.
 - Email must be UNIQUE.
 - JoinDate must be NOT NULL.
 - MembershipTypeID is an FK
 - MembershipType
 - MembershipTypeID is the PK.
 - TypeName (e.g., Basic, Premium) must be UNIQUE.
 - MonthlyFee must be positive (CHECK (MonthlyFee > 0)).
 - AccessLevel is text.
 - Instructor
 - InstructorID is the PK.
 - Phone must be NOT NULL.
 - Specialty is text.
 - Class
 - ClassID is the PK.
 - ClassName must be NOT NULL.
 - Capacity must be positive (CHECK (Capacity > 0)).
 - InstructorID is an FK
 - Registration
 - RegistrationID is the PK.
 - MemberID and ClassID are FKs.
 - RegistrationDate must be NOT NULL.
 - Status must have a default value 'ACTIVE' and allow only 'ACTIVE' or 'CANCELLED' (CHECK).

Q3. Schema Evolution – ALTER / MODIFY (6 marks)

Write the SQL statements that will perform the following schema changes after the tables have been created:

- a) Add a new column EmergencyContact (use VARCHAR with an appropriate size) to the Member table. This column should allow NULL values. (2 marks)
- b) Modify the Class table so that the Capacity column is defined as NOT NULL and must always be greater than 0 (use a CHECK constraint). (2 marks)
- c) Add a UNIQUE constraint on the Phone column in the Instructor table to ensure no two instructors share the same phone number. (2 marks)

Q4. Data Population – INSERT (6 marks)

Write SQL INSERT statements to populate the database with sample data as follows:

- a) Insert at least two rows into MembershipType, e.g. one for *Basic* and one for *Premium*. Ensure that MonthlyFee values are positive. (2 marks)
- b) Insert at least two rows into Instructor, with different specialties and unique phone numbers. (1 mark)
- c) Insert at least two rows into Member, linked to valid MembershipTypeID. Each member must have a unique email, valid join date, and other relevant details. (2 marks)
- d) Insert at least two rows into Class, each linked to a valid instructor and with a positive capacity. (1 mark)

Q5. SQL Queries – SELECT Statements (10 marks)

Using the UniFit Fitness Center database schema from the scenario, write SQL SELECT queries to answer questions a - the following. Each question carries 1 mark.

- a) List all members who joined after 1st January 2025. Display MemberID, FullName, and JoinDate.
- b) Find all female members who have a Premium membership. Display MemberID, FullName, Gender, and Membership type.
- c) Show all members who either joined in the year 2025 OR are on the basic membership. Display MemberID, FullName, JoinDate, and Membership type.
- d) List all instructors whose specialty contains the word Yoga. Display InstructorID, FullName, and Specialty.
- e) Display the names and email addresses of all members. Use column aliases so that the output headings read Member_Name and Contact_Email.
- f) List all members and the classes they are registered in, including the registration date. Results must be ordered first by ClassName, then by Member FullName.

- g) Show the total number of members per membership type. Display Membership type and the count of members.
- h) Find all classes that have more than 2 ACTIVE registrations. Display ClassName and the number of active registrations.
- i) List all members sorted by JoinDate in descending order (latest members first). Display MemberID, FullName, and JoinDate.
- j) Display the earliest JoinDate and the latest JoinDate from all members. Use column headings First_Member_Joined and Last_Member_Joined.

End of Exam