

Exam.	Results		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Database Management System (CT652)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Why data independence is importance in data modeling? Differentiate between physical and logical data independence. [4]
2. Draw an ER-diagram for the following mini-case. What is the difference between strong and weak entity sets?

Patients are treated in a single ward by the doctors assigned to them. Healthcare assistants also attend to the patients; a number of these are associated with each ward. Each patient is required to take a variety of drugs a certain number of times per day and for varying lengths of time. The system must record details concerning patient treatment and staff payment. Some staffs are paid part time and doctors and healthcare assistants work varying amounts of overtime at varying rates, the system will also need to track what treatments are required for which patients.

[8+4]

3. Write relational algebra queries for (a, b, c). Write SQL queries for (i, ii, iii)
 - a) Retrieve the detail of employee with eno, add, dob, phone with highest salary. [2]
 - i) Create above table Emp as indicated. [2]
 - ii) Find employee who earns more than 50000, works in CS department and name contains alphabet a. [2]
 - iii) Increase salary of those employee who earns less than average by 25% [2]
 - b) Find total amount spent by ECON department for its employee salary. [2]
 - c) Find total number of post in CS department. [2]
4. a) What is lossless decomposition and dependency preservation? Suppose that we decompose the schema $R = (A, B, C, D, E)$ into (A, B, C) and (C, D, E) . Is it lossless decomposition? Is it dependency preserving? [3+4]

Consider that the following set F of functional dependencies hold.

$A \rightarrow BC$
 $CD \rightarrow E$
 $B \rightarrow D$
 $E \rightarrow A$
- b) What is the importance of normalization? Define BCNF. [2+3]
5. Explain the steps involved in query processing. What is the significance of materialized views? [6+2]
6. Write about fixed-length record and variable length record organization DBMS. Define B+ tree structure used for indexing. [4+4]
7. Explain different states of a transaction along with state transition diagram. Explain conflict Serializability with example. [4+4]
8. Explain briefly two phase locking protocol for Concurrency Control. [4]
9. Explain in detail the working of log-based recovery method. [6]
10. Explain the importance of data warehouse in decision making. Write the application areas of spatial database. [3+3]

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1. What difficulties would you face if you used file system directly to implement a database application? What is physical data independence? [3+1]

2. Draw a complete ER-diagram for the following case.

"A Bus Company owns a number of busses. Each bus is allocated to a particular route, although some routes may have several busses. Each route passes through a number of towns. One or more drivers are allocated to each stage of a route, which corresponds to a journey through some or all of the towns on a route. Some of the towns have a garage where busses are kept and each of the busses are identified by the registration number and can carry different numbers of passengers, since the vehicles vary in size and can be single or double-decked. Each route is identified by a route number and information is available on the average number of passengers carried per day for each route. Drivers have an employee number, name, address, and sometimes a telephone number."

What is the difference between the degree and cardinality of a relationship? [8+4]

3. Consider the following relational database model

Employee(eid, name, address, supervisor_eid)
 Department(dept_id, name)
 Project(pid, title, dept_id)
 Works_on(eid, pid, hours)

Write relational algebra expressions for the following:

[2 X 4 = 8]

- a) List the name of all employees from Computer department along with the name of their supervisor.
- b) Find the name of all employees who work on the "Network monitoring" project for more than 15 hours.
- c) Delete all projects which belong to the "Electrical" department.
- d) Find the total number of projects from each department, along with the department name.

4. Consider the relational schema given below.

[2 X 4 = 8]

Product(pid, name, price, category, maker_cid)
 Purchase(buyer_ssn, seller_ssn, quantity, pid)
 Company(cid, name, stock price, country)
 Person(ssn, name, phone number, city).

- a) Write an SQL query to find the name and price of all products of "camera" category made in "Japan".
 - b) Write an SQL query to create a view to expose only the Buyer name, Seller name and product name from all transactions.
 - c) Write a query in SQL to Increase the price of all products from DELL company by 5 %.
 - d) Write skeleton tables in QBE to find the name and phone number of all persons who purchased products of Laptop category with price greater than 80,000.
5. a) Explain what is referential integrity constraint along with an example? Briefly explain cascading actions in referential integrity constraints. [3+3]
- b) Briefly explain how to normalize a database from un-normalized form to 1NF, 2NF, 3NF and 4NF? [6]
6. Explain the difference between cost-based and heuristics-based methods for query optimization. How can you optimize the following query? [3+5]

$\Pi_{name, title}(\sigma_{dept_name = 'Music'}(instructor \bowtie \Pi_{course_id, title}(teaches \bowtie course)))$

7. a) What is the difference between ordered indices and hash indices in a database? What is the advantage of using a sparse index? [2+2]
- b) What is a RAID? How would you choose the best RAID level for your database server? [1+3]
8. Explain Atomicity and Isolation properties of a database transaction. Describe the concept of conflict serializability for concurrent execution of transactions. [4+4]
9. Briefly explain the idea of a stable storage. Explain the architecture of a remote backup system. [3+3]
10. Write short notes on the following
- a) Types of distributed databases [3]
 - b) Data warehousing [3]

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1. Explain the difference between DDL, DML and DCL along with examples.

[4]

2. Assume that at Pine Valley Furniture each product (described by Product No., Description, and Cost) is comprised of at least three components (described by Component No., Description, and Unit of Measure) and components are used to make one or many products (i.e., must be used in at least one product). In addition, assume that components are used to make other components and that raw materials are also considered to be components. In both cases of components being used to make other components, we need to keep track of how many components go into making something else.

Draw an ER diagram for this case. Describe what is total participation using an ER-diagram example.

[5 + 4]

3. Consider the following relational database model

Product (pid, name, price, category, maker-aid)

Purchase (buyer-ssn, seller-ssn, quantity, pid)

Company (cid, name, stock price, country)

Person (ssn, name, phone number, city)

Write relational algebra expressions for the following.

[2 x 4]

- a) Find the ssn and name of all people who have purchased products of category "television"
- b) List the pid and name of all products which is more expensive than \$500 and made in China.
- c) Increase the price of all products of "television" category by 10%.
- d) List the ssn and name of each seller along with the total quantity of products sold.

4. Consider the relational schema given below.

[2 x 4]

Hotel (Hotel_No, Name, Address)

Room (Room_No, Hotel_No, Type, Price)

Booking (Hotel_No, Guest_No, Date_From, Date_To, Room_No)

Guest (Guest_No, Name, Address)

- a) Write an SQL query to list all guests who have booked rooms at the Himalayan Hotel.
- b) Write an SQL query to create a view to expose only the Hotel_No, Guest_No, Room_No and Price of the room of all booked rooms.
- c) Write a query to offer 5% discount on all rooms of type "Delux" for the Everest Hotel.
- d) Write skeleton tables in QBE to find the Check-in date and Name of all guests currently booked for the Everest Hotel.

5. a) Explain the necessary condition for decomposing a relational database table into two tables. Why is normalization needed? [4+4]
b) Compare 3NF and BCNF normal forms? [4]
6. Explain the process how a query is evaluated in RDBMS systems. How are equivalence rules for relation algebra helpful for query optimization? Explain with example. [3+5]
7. a) Distinguish between dense index and sparse index? What is a secondary index? [3+2]
b) Briefly explain how variable length records are stored in databases? [3]
8. What do you understand by the ACID properties of transactions? Explain with examples. [8]
9. Explain the functions of Undo and Redo operations in a log-based recovery of database. [6]
10. a) Briefly explain horizontal and vertical fragmentation in distributed databases. [3]
b) Write a short note on Data warehouse and associated applications. [3]

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1. Briefly explain different levels of data abstraction in a database system. [4]
2. Draw an ER-diagram for the following mini-case. What is the difference between strong and weak entity sets? [8+4]

Each employee in an engineering company has at most one recognized skill, but a given skill may be possessed by several employees. An employee is able to operate given machine-type (e.g., lathe, grinder) if he has one of several skills, but each skill is associated with the operation of only one machine type. Possession of a given skill (e.g., mechanic, electrician) allows an employee to maintain several machine-types, although maintenance of any given machine-type requires a specific skill (e.g., a lathe must be maintained by a mechanic).

3. Consider the following relational database model:

employee (employee-name, street, city)

works (employee-name, company-name, salary)

company (company-name, city)

manages (employee-name, manager-name)

- a) Write SQL queries for the following needs. [2×4]
 - i) Modify the database so that Jones now lives in city Pokhara.
 - ii) Give all employees of 'NABIL Bank' a 10 percent raise.
 - iii) Give all managers of 'NABIL Bank' a 30 percent raise unless the salary becomes greater than 100,000.
 - iv) Delete employee who has maximum amount of salary.
- b) The relation works has attribute company-name, company-name is primary key in relation company. How the relation between these two relations is preserved? Explain with solution with SQL query to achieve this relationship. [4]
4. a) What is a lossless-join decomposition? What is a functional dependency? Explain. [4+4]
- b) What is the advantage of 3NF over BCNF? [4]
5. What do you mean by term functional dependency? Discuss various types of functional dependencies. [6]
6. How can pipelining approach improve query-evaluation efficiency? [4]
7. a) What is the use of RAID storage device? What are the advantages and disadvantages of mirroring? [3+2]

- b) What is a remote backup system? Explain. [3]
8. a) List the ACID properties. Explain the usefulness of each. [4]
- b) During its execution, a transaction passes through several states, until it finally commits or aborts. List all possible sequences of states through which a transaction may pass. Explain why each state transition may occur. [4]
- c) How two phase locking protocol helps in avoiding deadlock? Explain with examples. [4]
9. Suppose following contents are present in the log when a crash occurs. Explain what happens for a log-based recovery. [6]

<T₀ start>
 <T₀, B, 2000, 2050>
 <T₁ start>
 <checkpoint {T₀, T₁}>
 <T₁, C, 700, 600>
 <T₁ commit>
 <T₂ start>
 <T₂, A, 500, 400>
 <T₀, B, 2000>
 <T₃ abort>

 <T₂, A, 500>
 <T₂ abort>

10. Briefly explain properties of distributed databases. [4]

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1. Briefly highlight your significant differences between a file-processing system and a DBMS. [4]

2. Draw an ER-diagram for the following mini-case. What is the difference between cardinality and degree of a relationship?

A university registrar's maintains data about the following entities: (a) Courses, including number, title, credits, syllabus and prerequisites; (b) Course offerings, including course number, year, semester, section number, instructor(s), timings and classroom; (c) Students, including student-id, name, and program; and (d) instructors, including identification number, name, department, and title. Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled. [8+4]

3. a. Mention the two conditions to be satisfied by any two sets for union, intersection and set difference operation between them. [1]

- b. employee(empname, street, city) [4×2]
- works(empname, companyname, salary)
- company(companyname, city)
- manages(empname, managemname)

For the case of above database schema:

- I. Write an expression in SQL to create the table employee.
- II. Write an expression in SQL to insert a row into the table works.
- III. Write an expression in SQL to find the name and cities of resident of all the employees who do not work for XYZ-Pvt. Ltd.
- IV. Write an expression Relational Algebra to find the company name that has the highest number of employees.

- c. Suppose you are assigned as the Database Administrator of a Bank. How can you enhance the security by implementing concept of views on the database? [3]

4. What do you mean by integrity constraints? Explain any four constraints that can be enforced to database tables. [6]

5. What are the advantages of normalization of database? Explain 1NF, 2NF and 3NF. When database de-normalization is preferred? [2+3+1]

6. Explain the process of query optimization. What is cost-based optimization? [6+2]

7. What do you mean by ordered index and hash index? Explain limitation of static hashing. How extendable hashing overcome such limitation? [2+2+4]

8. a) Explain conflict serializability with example. [8]
b) Differentiate between fine granularity and coarse granularity locking in multiple granularity locking protocol. [4]
- 9 Explain redo phase and undo phase of log based failure recovery mechanism. [6]
10. a) What is object-oriented databases? Explain briefly. [3]
b) Explain the benefit of parallel database? [3]

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1. What are the drawbacks of using file systems to store data? Explain. [6]

2. Draw an ER-diagram for the following mini-case

Procurement department of the Ministry of Transportation (MOT) keeps track of all the items (furniture and equipment such as a chair or printer) in the Ministry offices. There are several MOT buildings and each one is given a different name to identify it. Each item is assigned a unique ID when it is purchased. This ID is used to keep track of the item, which is assigned to a room within a building. Each room within a building is assigned to a department, and each department has a single employee as its manager. [8]

3. Consider the following relational database model

employee (person-name, street, city)
works (person-name, company-name, salary)
company (company-name, city)
manages (person-name, manager-name)

Write relational algebra expressions for the following: [2 X 4 = 8]

- Find the names and street address of all employees who work for First Bank Corp. and earn more than \$10,000 per annum.
- Find the names of all employees who do not work for First Bank Corp.
- Give all employees working at First Bank Corp. a 10 % salary raise.
- Count the number of employees in each company.

4. Consider the following relational database. [2 X 5 = 10]

account (account-number, branch-name, balance)
branch (branch-name, branch-city, assets)
customer (customer-name, customer-street, customer-city)
loan (loan-number, branch-name, amount)
depositor (customer-name, account-number)
borrower (customer-name, loan-number)

- Write an SQL query to list the names of all depositors along with their account number, street and city address.
- Write a query in SQL to list the branch-cities and total assets where the total assets are more than \$1,000,000 in the city.
- Write an SQL query to find the names and loan-numbers of all customers who have a loan of over \$15,000.
- Write a query in SQL to increase all accounts with balances over \$10,000 by 6%.
- Give an expression in QBE to find the customer-name, loan-number, and amount for all customers who have a loan from the "PATAN" branch.

5. Explain the conditions of BCNF. Compare BCNF and 3NF with example. [3+5]
6. Explain the process of query optimization. What is the significance of materialized views? [6+2]
7. What is RAID? Explain the B+ tree index with an example? [3 + 8]
8. Explain the granting and revoking of privileges to database users. [5]
9. Consider the following log contents when a crash occurs. Briefly explain how a recovery would be done. [5]

<T₀ start>
<T₀, A, 1000, 950>
<T₀, B, 2000, 2050>
<T₀ commit>
<T₁ start>
<T₁, C, 700, 600>

10. What is a transaction? What is a serializable schedule? [5]
11. a) What is an ORM? [3]
b) What is the difference between a homogeneous and a heterogeneous distributed database? [3]

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1. List and explain the five significant differences between a file processing and database management system. [5]
2. a) Construct an E-R diagram with proper mapping constraints for Registrar's Office that maintains data about courses, course offerings, students and instructors, enrollment of students in various courses and grades awarded to students in each course they are enrolled for must be appropriately modeled. [5]
b) What is data definition language? Explain strong and weak entity with suitable examples. [5]
3. Consider the relational data base as follows: [3x5]
employee (employee-name, street, city)
works (employee-name, company-name, salary)
company (company-name, city)
managers (employee-name, manager-name)
 - a) Write relational algebra to find the name of the manager who manages the employee "Shakti".
 - b) Write a SQL statement to find the name of all employees who live in the same cities and same streets as the employee "Achyt" and the same cities as the companies for which they work.
 - c) Write the QBE for: Delete all employees and who work for "XYZ" company.
 - d) Write an expression in tuple relational calculus to find the name of all employees who works for "ABC" company but do not earn more than 50000.
 - e) Write an expression in domain relational calculus to find the name of the employee, company name and salary for employee with earning over 50000.
4. a) What is normalization? What are their levels? State 3NF and BCNF. [2+1+4]
b) What do you mean by trivial and non-trivial functional dependencies? [3]
5. a) What do you mean by file organization? Why dynamic hashing is needed? [5]
b) Let $R = (A, B, C, D, E, F)$ and $F = \{A \rightarrow BC, E \rightarrow AF\}$. Decompose R to get all smaller relations in BCNF. [5]
6. a) What are the properties that must be hold by transaction? Explain the usefulness of each. [5]
b) Differentiate between primary index and secondary index. [5]
7. a) Explain deferred database modification technique of log based recovery with examples. [8]
b) How do you estimate query cost? [2]
8. Write short notes on: (any two) [2x5]
 - a) Object containment
 - b) Multiple granularity locking
 - c) Query optimization

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1. List and explain all the aspects of database system that might be subjects to change in physical storage. [6]
2. How do you represent composite and multivalued attributes of E-R diagram in tables? Explain with example. [4]
3. Construct an E-R diagram with proper mapping constraints, attributes and relationship sets for book shopping center that has entity sets book, author, publisher, customer, shopping-basket and warehouse. [4]
4. Consider the relational database as follow [2×7]
 - account (account-number, branch-name, balance)
 - branch (branch-name, branch-city, assets)
 - customer (customer-name, customer-street, customer-city)
 - loan (loan-number, branch-name, amount)
 - depositor (customer-name, account-number)
 - borrower (customer-name, loan-number)
 - a) Give an expression in the relational algebra to find the name of all customers who have a loan at KANTIPATH branch but do not have an account at any branch of the bank.
 - b) Give an expression in the relational algebra to find the name of all customers who live in the same street as BINOD.
 - c) Give an expression in tuple relational calculus to find the name of all customers who have a loan and an account at the bank.
 - d) Give an expression in domain relational calculus to find the name of all customers who have a loan of over \$12000.
 - e) Give an expression in SQL to delete all loans with loan amount between \$1400 and \$1700.
 - f) Give an expression in SQL to find the name of all customers who have a loan at the bank but do not have an account at the bank.
 - g) Give an expression in QBE to provide as a gift for all loan customers of the PATAN branch, a new \$200 savings account for every loan account they have, with the loan number serving as the account number for the new savings account.
5. a) Suppose that we decompose the schema $R = (A, B, C)$ into $R_1 = (A, B)$, $R_2 = (A, C)$. Show that this decomposition is a lossless-join decomposition and not dependency preserving if the $F = \{A \rightarrow B, B \rightarrow C\}$. [6]

- b) What are the minimal conditions that must be hold by a relation schema R to be in third normal form (3NF)? [2]
6. What are the major disadvantages of using materialization approach for evaluation of expression? And how does pipelining approach overcome those disadvantages? [6]
7. Discuss the pointer method to represents the variable records by fixed-length representation. How does anchor and overflow block improve the pointer method? [6]
8. What are the different roles are created and granted to users in database? Discuss the authorization grant graph and attempt to defeat authorization revocation. [2+2]
9. How checkpoint mechanism improves the performance of log based crash recovery techniques? Explain. [8]
10. What do you mean by cascading rollback and why this must be removed? How strict two phase locking protocol improves the two phase locking protocol? [3+3]
11. How and why data replication and fragmentation techniques are used in distributed data storage? [6]
12. Write short notes on: [2×4]
- a) Recursive Relationship
 - b) Compensating Transaction
