

**Tribhuvan University**  
**Institute of Science and Technology**  
2067  
☆

Bachelor Level/ Second Year/ Fourth Semester/ Science  
**Computer Science and Information Technology (CSc. 253)**  
(Database Management System)

Full Marks: 60  
Pass Marks: 24  
Time: 3 hours.

**Attempt all the questions.**

1. Answer the following questions in short: (5 x 2 =10)
  - a) Differentiate between logical data independence and physical data independence.
  - b) Three-schema architectures.
  - c) Differentiate between database schema and a database state.
  - d) Different type of data attributes.
  - e) The difference among a relationship instance, a relationship type, and relationship set.
2. a) Draw an ER diagram for database showing Bank. Each Bank can have multiple branches, and each branch can have multiple accounts and loans. (6)  
b) In what sense does a relational calculus differ from relational algebra, and in what sense are they similar? (4)
3. a) Assume a database about Company. (5)  
EMPLOYEE (ss#, name)  
COMPANY (cname, address)  
WORKS (ss#, cname)  
SUPERVISE ( supervisor\_ss#, employee\_ss#)  
  
Write relational algebra and SQL queries for each of the following cases.
  - i) Find the names of all supervisors that work in companies whose address equals 'pokhara'.
  - ii) Find the name of all the companies who have more than 4 supervisors.
  - iii) Find the name of supervisor who has the largest number of employees.  
b) What is a view in SQL and how it is defined? Explain how views are typically implemented. (5)
4. a) Define a first, second, and third normal forms with suitable examples. (5)  
b) What is a functional dependency? When are two sets of functional dependencies equivalent? How can we determine their equivalence? (1+2+2)
5. a) Discuss the ACID properties of a database transaction with suitable example. (5)  
b) Describe the serial and serializable schedule? Why serializable schedule is considered correct?
6. a) How does the granularity of data items affect the performance of concurrency control? What factors affect selections of granularity size for data items? (5)  
b) Describe the two-phase commit protocol for database transaction. (5)

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**Attempt all the questions.**

1. Answer the following questions in short. (5x2=10)
  - a. Advantage of DBMS approach over file system approach.
  - b. Differentiate between two-tier and three-tier client/server architecture.
  - c. What is weak entity, owner entity type and identifying relationship?
  - d. The null value attribute and its uses.
  - e. Recursive relationship type with suitable example.
- 2.a) Draw an ER diagram for a database showing Hospital system. The Hospital maintains data about Affiliated Hospitals, type of Treatments facilities given at each hospital, and Patients. (6)
- b) What is join operation? Differentiate between equijoin and natural join with suitable example. (4)
- 3.a) Assume a database about **Company**.  
EMPLOYEE (ss#, name)  
COMPANY (cname, address)  
WORKS (ss#, cname)  
SUPERVISES (supervisor\_ss#, employee\_ss#)  
  
Write relational algebra and SQL queries for each of the following cases. (5)
  - (i) Find the names of all the supervisors that work in companies whose address equal 'Kathmandu'.
  - (ii) Find the names of all the companies who have more than 4 supervisors.
  - (iii) Find the name of the supervisor who has the largest number of employees.
- b) How can define view in SQL? Explain the problems that may arise when one attempts to update a view. (1+4)
- 4.a) What are different update anomalies? Explain each in with suitable example. (1+4)
- b) Define functional dependency. Describe the closure of a set of functional dependencies with an example. (1+4)
- 5.a) Draw a state diagram, and discuss the typical state that a transaction goes through during transaction. (5)
- b) Which of the following schedule is (conflict) Serializable? For each serializable schedule, determine the equivalent serial schedules. (5)
  - i) r1(x); r3(x); w1(x); r2(x); w3(x);
  - ii) r1(x); r3(x); w3(x); w1(x); r2(x);
  - iii) r3(x); r2(x); w3(x); r1(x); w1(x);
  - iv) r3(x); r2(x); r1(x); w3(x); w1(x);
- 6.a) Discuss the problems of deadlock and starvation, and the different approaches to dealing with these problems. (5)
- b) Describe write-ahead logging protocol. (5)

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*Candidates are required to give their answers in their own words as far as practicable.*  
The figures in the margin indicate full marks.

**Attempt all the questions.**

1. Answer the following questions in short:: (5 x 2 = 10)
  - (a) Differentiate between program-data independence and program-operation independence.
  - (b) The ANSI/SPARC architecture with diagram.
  - (c) Differentiate between procedural and nonprocedural DMLs.
  - (d) The difference among an entity, an entity type, and an entity set.
  - (e) When is the concept of a weak entity is used in data modeling?
2. (a) Draw an ER diagram for a database to keep track of the teams and games of a sport league. A team has a number of players, not all of whom participate in each game. It is desired to keep track of the players participating in each game for each team, the position they played in that game, and the result of the game. (6)
- (b) What is union compatibility? Define operations union, intersection, and difference on two union compatible relations R and S with suitable example. (4)
3. (a) Describe the different clauses in the syntax of an SQL query, and show what type of constructs can be specified in each clause. (5)
- (b) What is constraint? How does SQL allow implementation of general integrity constraints? (1+4)
4. (a) Define Boyce-Codd normal form. How does it differ from 3 NF? Why is it considered a stronger form of 3NF? (1+4)
- (b) What is functional dependency? Describe full and partial functional dependency with suitable example. (1+4)
5. (a) Discuss the ACID properties of a database transaction with suitable example. (5)
- (b) What is schedule? Define the concept of recoverable, cascadeless, and strict schedule, and compare them in terms of their recoverability. (1+4)
6. (a) What is the two-phase locking protocol? How does it guarantee serializability? (5)
- (b) What do you mean by transaction rollback? What is meant by cascading rollback? Why do practical recovery methods use protocols that do not permit cascading rollback? (5)

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**Attempt all the questions.**

1. Answer the following questions in short: (5 x 2 = 10)
  - a) Differentiate between two-tier and three-tier client/server architecture.
  - b) The null value attribute and its uses.
  - c) Difference between logical data independence and physical data independence.
  - d) When is the concept of a weak entity used in data modeling?
  - e) The difference among a relationship instance, a relationship type, and relationship set.
2. a) Draw an ER diagram for database showing hospital system. The Hospital maintains data about affiliated Hospitals, type of treatments facilities given at each hospital and patients. (6)
- b) In what sense does a relational calculus differ from relational algebra, and in what sense are they similar? (4)
3. a) Assume a database about Company. (5)  
  
EMPLOYEE (ss#, name)  
COMPANY (cname, address)  
WORKS (ss#, cname)  
SUPERVISE ( supervisor\_ss#, employee\_ss#)  
  
Write relational algebra and SQL queries for each of the following cases.
  - i) Find the names of all supervisors that work in companies whose address equals 'Biratnagar'.
  - ii) Find the name of all the companies who have more than 10 employees.
  - iii) Find the name of supervisor who has the minimum number of employees.
- b) What is constraint? How does SQL allow implementation of general integrity constraints? (1+4)
4. a) Define a first, second, and third normal forms with suitable examples. (5)
- b) What is a functional dependency? Describe full and partial dependency with suitable example. (1+4)
5. a) Draw a state diagram, and discuss the typical state that a transaction goes through during transaction. (5)
- b) Describe the serial and serializable schedule? Why serializable schedule is consider correct? (5)
6. a) How does the granularity of data items affects the performance of concurrency control? What factors affect selections of granularity size for data items? (5)
- b) Describe write ahead logging protocol. (5)

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Full Marks: 60  
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**Attempt all the questions.**

1. (a) What is database management system? Discuss the advantages of using database management system over file system. (2+3 =5)  
(b) What is data abstraction? Discuss three levels of this abstraction. (1+4=5)
2. a) Construct an ERD to record the marks that students get in different exams of different course offerings. (5)  
b) Define integrity constraint? Discuss domain constraint with suitable example. (1+4=5)
3. a) With the information given below, calculate any three members of  $F^*$ . (6)  
 $R = (A, B, C, G, H, I)$   
 $F = \{A \rightarrow B, A \rightarrow C, CG \rightarrow I, B \rightarrow H\}$   
b) Discuss 2NF and 3NF with suitable example. (4)
4. Consider the following supplier database, where primary keys are underlined: (20)  
Supplier (supplier-id, supplier-name, city)  
Supplies (supplier-id, part-id, quantity)  
Parts (part-id, part-name, color, weight)  
Construct the following relational algebra queries for this relational database
  - a) Find the name of all supplies located in city "Kathmandu".
  - b) Find the name of all parts supplied "ABC Company".
  - c) Find the name of all parts that are supplied in quantity greater than 300.
  - d) Find the number of parts supplied by "ABC Company".
  - e) Find the name of all suppliers who supply more than 30 different parts.
5. a) What is serializable schedule? How can you test a schedule for conflict serializability?. (2+3=5)  
b) Discuss recovery technique based on deferred update with concurrent execution in multi-user environment. (5)

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**Attempt all the questions.**

1. a) Why do we need database management system? Discuss drawbacks of file system and advantages of database management system. [2+3]  
b) What is database system architecture? Describe three levels and benefits of this architecture. [1+4]
2. A database is being constructed to keep track of the teams and games of a sports league. A team has a number of players, not all of whom participate in each game. If is desired to keep track of the players participating in each game. Design an ER diagram for this application. [10]
3. (a) Define integrity constraint? Discuss referential integrity in detail. [1+4]  
(b) What is functional dependency? How can we use functional dependency to normalize a relation in 3NF? Discuss with suitable example. [1+2+2]
4. Consider the following employee database, where primary keys are underlined. [10]  
*employee* (employee-name, street, city)  
*works* (employee-name, company-name, salary)  
*company* (company-name, manager-name)  
*manages* (employee-name, manager-name)  
Give an expression in SQL for each of the following queries.
  - a) Find the names of all employees who work for Second Bank Corporation.
  - b) Find the names, street and cities of residence of all employees who work for Second Bank Corporation.
  - c) Find the names, street addresses, and cities of residence of all employees who work for Second Bank Corporation and earn less than \$10,000.
  - d) Find the names of all employees who work under the manager “Devi Prasad”.
  - e) Find the number of employees having salary greater than or equal to 20000.
5. (a) Why do we need concurrency control mechanism? Discuss basic, conservative, and rigorous two phase locking algorithm. [2+3]  
(b) What is shadow paging? How can we use this technique to recover our database? [5]

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  - d) Different types of data attributes.
  - e) Differentiate between program-data independence and program-operation independence.
2. (a) Given an ER diagram for a database showing Bank. Each Bank can have multiple Branches, and each branch can have multiple accounts and loans. [6]  
(b) What is union compatibility? Define operations union, intersection, and difference on two union compatible relations R and S with suitable example. [4]
3. (a) Describe the different clauses in the syntax of an SQL query, and show what types of constructs can be specified in each clause. [5]  
(b) How view is defined in SQL? Explain the problems that may arise when one attempts to update a view. [1+4]
4. (a) Define Boyce-Codd normal form. How does it differ from 3NF? Why is it considered a stronger form of 3NF? [1+4]  
(b) What is a functional dependency? When are two sets of functional dependencies equivalent? How can we determine their equivalence? [1+4]
5. (a) Discuss the ACID properties of a database transaction with suitable example. [5]  
(b) Indicate how the recovery scheme works in a single user environment if the system fails
  - i) After the transaction starts and before the read.
  - ii) After the read and before the write.
  - iii) After the write and before the commit.
  - iv) After the commit and before all database entries are flushed onto disk. [5]
6. (a) What is the two-phase locking protocol? How does it guarantee serializability? [5]  
(b) What is meant by transaction rollback? What is meant by cascading rollback? Why do practical recovery methods use protocols that do not permit cascading rollback? [5]

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