DATABASE MANAGEMENT SYSTEMS I
(MCAP 1203)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   Check constraint is also known as
            (a) referential integrity   (b) domain integrity
            (c) entity integrity   (d) key integrity.

    (ii)   Dependency preservation is not guaranteed in
            (a) BCNF   (b) 3NF   (c) 2NF   (d) None.

    (iii)   A relation is in .... if an attribute of a composite key is
            dependent on an attribute of other composite key.
            (a) 2NF   (b) 3NF   (c) BCNF   (d) 1NF.

    (iv)   Different values for the same data item is referred to as
            (a) data consistency   (b) data inconsistency
            (c) data integrity   (d) data duplication.

    (v)   The term attribute refers to a _____ of a table.
            (a) record   (b) column   (c) tuple   (d) key.

    (vi)   A _____ in a table represents a relationship among a set of values.
            (a) column   (b) key
            (c) row   (d) entry.

    (vii)   All aggregate functions except ____ ignore null values in their input
            collection.
            (a) Count(attribute)   (b) Count(*)
            (c) Avg(attribute)   (d) Sum(attribute)

(viii) The _____ operator preserves unmatched rows of the relations being joined.
(a) inner join   (b) outer join
(c) union   (d) union join.

(ix) Index which has an entry for some of key value is classified as
(a) linear index   (b) dense index
(c) non dense index   (d) cluster index.

(x) The subquery is known as a _____ subquery because the subquery is related to the outer SQL statement.
(a) relational   (b) related
(c) correlated   (d) correlational.

Group – B

2. (a) What is data independence? How is physical data independence different from logical data independence?

(b) What is data abstraction? Discuss different levels of data abstraction. List three significant differences between a file-processing system and a DBMS.

$$(2 + 2) + (2 + 3 + 3) = 12$$

3. (a) A university registrar's office maintains data about the following entities:
- *Courses* – Identified by course number, title, credits, syllabus, and prerequisites.
- *Course offerings* - Identified by course number, year, semester, section number, instructor(s), timings, and classroom.
- *Students* - Identified by student-id, name, and program.
- *Instructors* - Identified by identification number, name, department, and title.

Further, the enrolment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modelled.

Construct an E-R diagram for the registrar's office. Document all assumptions that you make about the mapping constraints.

(b) A weak entity set can always be made into a strong entity set by adding primary key attributes of its identifying entity set. Outline what sort of redundancy will result, if we do so.

$$8 + 4 = 12$$

(iii) List the publishers along with the number of books published by them.

(iv) For each publisher, find the names of employees who have borrowed more than 3 books of that publisher.

$$(2 × 2) + (4 × 2) = 12$$

Group – E

8. (a) What do you mean by fixed-length records and variable-length records?

(b) Construct a B+ tree for the following set of key values under the assumption that the number of key values that fit in a node is 3:
Key values : 3, 10, 12, 14, 29, 38, 45, 55, 60, 68
Show the steps involved in the following insertion: Insert 13.
Show the steps involved in the following deletions: delete 12.

$$4 + (4 + 2 + 2) = 12$$

9. (a) What is the advantage of creating materialized view? What is updateable view? When a view cannot be updated?

(b) What is the difference between a primary index and a secondary index? When is it preferable to use a dense index rather than a sparse index?

$$(2 + 2 + 3) + (3 + 2) = 12$$

Group – C

4. (a) Differentiate among super key, candidate key and primary key. What is a system catalog? What do you mean by entity integrity and domain integrity in relational model?

    (b) Suppose that we decompose the schema R = (A, B, C, D, E) into R1(A, B, C) and R2(A, D, E). Show that this decomposition is a lossless-join decomposition if the following set F of functional dependencies holds:
    A → BC
    CD → E
    B → D
    E → A

    (3 + 2 + 2) + 5 = 12

5. (a) What is functional dependency? Why certain functional dependencies are called trivial functional dependencies? Explain full functional dependency with an example.

    (b) Consider the following set of functional dependencies on the relation schema CleintRental (clientNo, cName, (propertyNo, pAddress, rentStart, rentFinish, rent, ownerNo, oName))
    clientNo, propertyNo → rentStart, rentFinish
    clientNo → cName
    propertyNo → pAddress, rent, ownerNo, oName
    ownerNo → oName
    clientNo, rentStart → propertyNo, pAddress, rentFinish, rent, ownerNo, oName
    propertyNo, rentStart → clientNo, cName, rentFinish

    Decompose the CleintRental relation into 3NF.

    (2 + 2 + 2) + 6 = 12

Group – D

6. (a) Consider the relational database given bellow, where the primary keys are underlined.

    employee (<u>person-name</u>, street, city)
    works (<u>person-name</u>, company-name, salary)
    company (<u>company-name</u>, city)

    Give an expression in the relational algebra to express each of the following queries:

(i)   Find the names and cities of residence of all employees who work for SBI.

(ii) Find the names, street address, and cities of residence of all employees who work for SBI and earn more than 1,00,000 per annum.

(iii) Find the names of all employees in this database who live in the same city as the company for which they work.

(b)   Consider the relational database given bellow, where the primary keys are underlined.
Supplier(Sno, Sname, City)
Part(Pno, Pname, Qty-in-stock)
Supply(Sno, Pno, Qty)
Write SQL statements for the following:
  (i)   Get names of the suppliers who do not supply part number 3.
  (ii) For each part supplied, get the part number and the total supplied quantity.
  (iii) Get all pairs of supplier numbers such that the two suppliers are located in the same city.
  (iv) Get the maximum and minimum supplied quantity for part number 3.

$$(3 \times 2) + (4 \times 1.5) = 12$$

7. (a)   Consider the relational database given bellow, where the primary keys are underlined.
student (rollNo, name, degree, year, sex, deptNo, advisor)
department (deptId , name, hod, phone)

Give an expression in the Tuple Relational Calculus (TRC) to express each of the following queries:
  (i)   Determine the departments that do not have any girl students.
  (ii) Obtain the rollNo, name of all girl students in the Maths Dept.

(b)   Consider the following relational schema for a departmental library.
Employee(empno, name, office, age)
Books(isbn, title, author, publisher)
IssueRegister(empno, isbn, date)
Write the following queries in SQL.
  (i)   Find the names of employees who have borrowed a book published by TMH.
  (ii) Find the names of employees who have borrowed all books published by TMH.