

DATABASE MANAGEMENT SYSTEMS (MCAP 2101)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one 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) Consider a B+-tree in which the maximum number of keys in a node is 5. What is the minimum number of keys in any non-root node?
 (a) 1 (b) 2 (c) 3 (d) 4.
 - (ii) In a relation R, a multivalued dependency $A \twoheadrightarrow B$ is called trivial if
 (a) $A \cap B = \Phi$ (b) $B \cup A = R$ (c) either (a) or (b) (d) none of them.
 - (iii) What are the desirable properties of a decomposition?
 (a) Partition constraint (b) Dependency preservation
 (c) Redundancy (d) Security.
 - (iv) If a schedule S can be transformed into a schedule S' by a series of swaps of non-conflicting database read/write instructions, then S and S' are always:
 (a) Conflict Equivalent to each other (b) View Equivalent to each other
 (c) both (a) and (b) (d) none of these.
 - (v) Which of the following are steps in query processing?
 (a) Parsing and translation (b) Optimization
 (c) Evaluation (d) All of the above.
 - (vi) Which of the following statement is true?
 (a) Isolation property of a transaction can never be achieved under a concurrent execution schedule of transactions.
 (b) Atomicity property of transaction can only be achieved under a serial execution schedule of transactions.
 (c) Consistency property of a transaction can be achieved by controlling concurrency of a executing schedule of transactions.
 (d) Durability property of a transaction can only be achieved by controlling concurrency executing schedule of transactions.
 - (vii) The index which has an entry for every key value is classified as
 (a) Sparse Index (b) Linear Index (c) Dense Index (d) Cluster Index.

(viii) Relation $R=(A,B,C,D)$ with AB as primary key. Choose one FD such that R should be in 1NF but not in 2NF.

- (a) $AB \rightarrow C$ (b) $AB \rightarrow D$ (c) $A \rightarrow D$ (d) $AB \rightarrow CD$

(ix) Consider the following **DDL** statement: Create table Employee(empId number(5) primary key, salary number(10,2), deptno number(5) references Department(deptId)); Which of the following is true

- (a) deptId of Department table must be a foreign key
 (b) deptId of Department table must be candidate key
 (c) deptno of Employee table must be a primary key
 (d) None of these.

(x) Which of the following concurrency control protocols ensure both conflict serializability and freedom from deadlock?

I. Two-Phase locking II. Time-Stamp ordering

- (a) I only (b) II only (c) both I and II (d) neither I nor II.

Group- B

2. (a) Explain Database and DBMS with relevant example. Find a Relational Algebra expression to find the largest account balance in the bank where Account is described as(branch_name , account_no, balance). [(CO1)(Explaining/LOCQ)]

(b) Let $R(W,X,Y,Z)$ be a relation schema. Find the irreducible set of functional dependencies of a set F where F is given as $\{X \rightarrow W, WZ \rightarrow XY, Y \rightarrow WXZ\}$.

[(CO2)(Exemplifying/LOCQ)]

(c) Let us consider the relation schema $R(ABCDE)$ with the set of functional dependencies $F=\{A \rightarrow B, BC \rightarrow D, E \rightarrow C, D \rightarrow A\}$. Construct the set of all candidate keys.

[(CO2)(Construct/LOCQ)]

(2 + 3) + 5 + 2 = 12

3. (a) Interpret the canonical form of the following set of FD given, explaining each step.

(1) $A \rightarrow BC, AB \rightarrow D, AC \rightarrow D$.

Explain the transitive dependency with example. [(CO2)(Interpret/LOCQ)]

(b) Suppose that we have the following four tuples in a legal instance of a relational schema R with three attributes ABC (listed in order): (1,1,1), (2,1,0), (3,3,2) and (4,3,2).

(i) Which of the following dependencies that can you infer does not hold over the schema R?

(a) $A \rightarrow B$, (b) $BC \rightarrow A$, (c) $B \rightarrow C$.

(ii) Can you identify any dependencies that hold over S? [(CO2)(Explore/IOCQ)]

(c) Give a set of FDs for the relation schema $R(A,B,C,D)$ with primary key AB under which R is in 1NF but not in 2NF----- Justify your answer. [(CO2)(Create/HOCQ)]

4 + 5 + 3 = 12

Group - C

4. (a) Based on the following schema answer the queries given below in SQL.

Student(st_num, st_name, major, grade, age)

Class(cname, meet_at_time, room, fac_id)

Enrolled(st_num, cname)

Faculty(fac_id, fname, deptid)

- (1) Find the names of all grade 10's who are enrolled in a class taught by "John Smith".
- (2) Find the names of all classes that either meet in room 5NE or have five or more students enrolled.
- (3) Find the names of all students who are enrolled in two classes that meet at the same time.
- (4) Define a view part_time_students(st_num, st_name, major, grade, age) where a student is considered part-time if he or she takes less than 5 courses.

[(CO3)(Apply/IOCQ)]

- (b) Briefly explain different types of join in SQL.

[(CO3)(Remember/LOCQ)]

(2.5 × 4) + 2 = 12

5. (a) Consider the following relations:

- (i) **Employee** (Emp_Code, Emp_Name, Desig, Manager, Date_of_Joining, Salary, Dept_Code) With Constraints: **Primary Key** is Emp_Code, **Foreign Key**: Manager references Employee(Emp_Code), Dept_Code references Department(Dept_Code).
- (ii) **Department** (Dept_Code, Dept_Name, Location) With Constraints: **Primary Key** is Dept_Code.

Write the following queries in SQL:

- (1) List the average salary and number of employees working in each department.
- (2) List the names of those departments where the total salary is greater than 15000.
- (3) List the names of the employees and the names of their managers under whom they are working.

[(CO3) (Apply/IOCQ)]

- (b) Consider a relational database as given below:

Customer(cust-id, cust-name, cust-city)

Product(p-id, p-name, p-rate)

Sale-Details(cust-id, p-id, p-rate, p-count, sale-date)

where the underlined attributes are the primary keys.

Write the following queries using SQL:

- (1) Find the number of 'Soap' (p-name) purchased by customer 'Karina'.
- (2) Find the customer ids of those who have ordered products that were not ordered by customer 'Raj'.
- (3) Find customer names of those who have purchased the product 'Soap' on or before 21st September, 2019.

[(CO3)(Apply/IOCQ)]

(2 × 3) + (2 × 3) = 12

Group - D

6. (a) Assume Salary table contains salary and emp_id of each employee. Write PL/SQL cursor to display details of Highest 10 salary paid employees. [(CO4)(Apply/IOCQ)]
- (b) Explain differences between Implicit Cursors and Explicit Cursors with example.

[(CO4)(Analyse/IOCQ)]

- (c) How PL/SQL get executed using Oracle Engine?

[(CO4)(Remember/LOCQ)]

5 + 4 + 3 = 12

7. (a) Consider the following Employee schema:

Employee (empNo, empName, empAddress, empSalary)

Apply a PL/SQL cursor to display the details of 10 highest salaried employees.

[(CO4)(Apply/IOCQ)]

- (b) What is the importance of %TYPE and %ROWTYPE data types in PL/SQL?
[[CO4](Remember/LOCQ)]
- (c) Construct a trigger to calculate the Income Tax amount and insert it in EMP(name,id,salary,income_tax) table.
If salary ≥ 50000 then income_tax = 10%
If salary ≥ 100000 then income_tax = 15%
If salary ≥ 200000 then income_tax = 20%.
[[CO4](Apply/IOCQ)]
4 + 3 + 5 = 12

Group - E

8. (a) Consider two transactions T1 and T2 and the concurrent schedule S. The read and write operations are given below.
T1: r1(X); w1(X); r1(Y); w1(Y) T2: r2(X); w2(X); r2(Z); w2(Z)
S = r1(X);w1(X);r2(X);w2(X);r1(Y);w1(Y);r2(Z);w2(Z)
Find out (without using graph) whether the schedule S is conflict serializable.
[[CO5](Judging/HOCQ)]
- (b) Suppose that an ordered file with r = 60000 records stored on a disk with block size B = 1024 bytes. File records are of fixed size with record length R = 1000 bytes.
(i) Find out the blocking factor and the number of blocks needed for the file.
Suppose a primary index is created on the above file, with ordering key field 12 bytes and block pointer 8 bytes.
(ii) Find the blocking factor for the index.
(iii) Find the total number of blocks in the index.
(iv) Find how many block access is required to access particular record.
[[CO6](Execute/IOCQ)]
- (c) Explain with examples, The Lost Update problem and Dirty Read problem.
[[CO5](Explain/LOCQ)]
4 + 5 + 3 = 12
9. (a) Summarise the ACID properties of Transaction. [[CO5] (Summarise/LOCQ)]
(b) Focus on the different Ordered Indexing Methods? What are the advantages and disadvantages of primary index method? [[CO6] (Focusing/IOCQ)]
(c) Explain the requirement of concurrent executions of transaction.
[[CO5] (Understand/LOCQ)]
4 + 5 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	45.83	46.88	7.29

Course Outcome (CO):

- After the completion of the course students will be able to
- MCAP2101.1 :** Apply relational algebra to interpret data in relational format.
- MCAP2101.2 :** Design a relational database with proper normal form.
- MCAP2101.3 :** Perform SQL to access data in relational databases.
- MCAP2101.4 :** Implement PL/SQL programming using concept of cursor management, function, error handling, package and triggers.
- MCAP2101.5 :** Analyze the concept of a database transaction, concurrency control and its role in maintaining the database's integrity.
- MCAP2101.6 :** Demonstrate the concept of different levels of indexing to optimize query processing.
- *LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question