DATABASE MANAGEMENT SYSTEMS
(INFO 2204)

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) A relation R with attributes A, B, C, D is decomposed into R1(B, C, D) and R2 (A, B), where B is the candidate key of R1. Which of the following statement (St.) is/are true?
Statement1 - The decomposition is lossy
Statement2 - The deposition is lossless
Statement3 - Attribute B of R2, is the foreign key referencing to R1
Statement4 - Attribute B of R1 is also the foreign key referencing to R2
(a) Statement2 only (b) Statement1 & Statement2
(c) Statement3 only (d) Statement2 & Statement3.

(ii) A user performs the following operations: insert, delete, create table, update, delete insert, commit. The number of transaction/s performed by the user is
(a) 2 (b) 6 (c) 1 (d) 3.

(iii) Clustering index is a ---------- index.
(a) Sparse (b) Dense (c) Hash (d) None of them

(iv) With reference to referential integrity constraint which of the following statement/s (St.) is/are true
Statement1 - No tuples can be inserted in the parent table if it is not present in child table.
Statement2 - No tuples can be inserted in the child table if it is not present in parent table.
Statement3 - No tuple can be deleted from parent if it is referenced by child.
(a) Statement1 & Statement (b) Statement2 & Statement3
(c) Statement3 only (d) Statement2 only.

(v) A relation R(A,B,C) has the FD set F - {A--> B and AB --> C} . The canonical cover of F is
(a) {A --> C} (b) {A-->B} (c) {AB-->C} (d) {B-->C}.

(vi) Wait-die scheme for preventing deadlock is a
(a) Pre-emptive Scheme based on time-stamp
(b) Non-pre-emptive scheme
(c) Preemptive Scheme
(d) Non-preemptive Scheme based on timestamp.

(vii) With reference to Transaction/schedule which of the following statement/s is/are true?
Statement1 - A transaction ends before a commit or rollback
Statement2 - A transaction begins after a commit or rollback
Statement3 - A transaction can be partially rollback using savepoint
Statement4 - A transaction may consist of multiple dml statements
(a) Statement1 & Statement2 (b) Statement1, Statement4
(c) Statement1, Statement2, Statement3, Statement4 (d) Statement3.

(viii) The first level in a multilevel indexing has b blocks, with fan out f. Therefore the number of blocks in 3rd level is
(a) ceil(b/f) (b) ceil(b/f^2) (c) floor(b/f) (d) ceil(b/f^3).

(ix) A serial schedule S' is generated after swapping the non-conflicting statements of a schedule S. Therefore S is
(a) Conflict Serializable (b) View equivalent
(c) Conflict Equivalent (d) View Serializable.

(x) In a B Tree of order 4 each internal node will have a maximum ---------- number of search key values.
(a) 4 (b) 6 (c) 3 (d) 5

Group - B

2. (a) Site an example to explain the concept of self referential integrity constraint. *[(CO1)(Understand/LOCQ)]*

(b) Construct an ER diagram for a car insurance company whose customers own one or more cars each. Each car is associated with it zero to any number of recorded accidents. Each insurance policy covers one or more cars and has one or more premium payments associated with it. Each payment is for a particular period of time, and has an associated due date. Suitable attributes should be included along with cardinality. Map the ER model to relational model, as per the cardinality. Mention the foreign key relationship that exists. *[(CO2)(Analyse/IOCQ)]*

5 + 7 = 12

3. Consider the following relational schemas. Write **Relational Algebra** and **SQL** for the following queries.
Student(id, name) , **EnrolledIn**(id, code), **Subject**(code, lecturer-names)
   1. What are the names of students enrolled in subject with code IT-3312?
   2. Which subjects are taken by lecturer Steve?
   3. Who teaches subject having code IT-2234?
   4. Who teaches subject having code IT-1500 or IT-3020?
   5. Who teaches at least two different subjects?
   6. What are the names of students enrolled in subjects IT-1500 or IT-3010? *[(CO3)(Evaluate/HOCQ)]*

(6 + 6) = 12

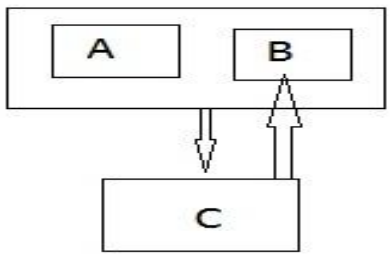
Group - C

4. (a) Given a database schema Plane-Info (flight_no, date, miles, plane, airlines, from, to). The following FD's holds on the relation.
(flight_no , date)→ plane
flight_no→ (airlines, to, from, miles)
(from, to) → miles
(i) Find the candidate key/keys
(ii) Find the normal form in which it exists
(iii) Step by Step Decompose the relation to BCNF preserving dependency. *[(CO2,CO3)(Evaluate/HOCQ)]*

(b) Find the canonical cover of F1, and thereby find whether F1 is equivalent to F2
F1 = { T→U, TU→ Z, D→TZ, D→E}
F2= {T→UZ, D→TE} *[(CO2,CO3)(Apply/IOCQ)]*

8 + 4 = 12

5. (a) A relation R with attributes A,B,C have the following FDs holding on it: Normalize R into BCNF. *[(CO2,CO3)(Apply/IOCQ)]*



(b) Consider the relation where details of an employee of the company with respect to projects and movie ticket id is maintained. An employee can book more than one movie ticket and an employee can be associated with more than one project. Identify the dependencies among attributes (if any). Determine whether the relation is in 4NF, if not convert the relation to 4NF

Emp_id	Project_id	Movie ticket id

[(CO3)(Apply/IOCQ)]

6 + 6 = 12

Group - D

6. (a) Consider the following two tables. Write a **PL/SQL Trigger** such that whenever a user tries to to delete internship records from T2, corresponding record in T1 gets deleted first and then the record from T2 gets deleted. Note: A referential integrity constraint exists between T1 and T2.

Table T1

Roll	Internship
1	I1
2	I2
3	I1

Table T2

Internship	Date
I1	24-Apr-2023
I2	12-Jun-2023

[(CO3)(Apply/IOCQ)]

(b) Consider 2 transaction T1 and T2 running in a centralized environment such that
T1 : read(Z) write(Z) read(X) write(X)
T2 : read(Z) write(Z) read(X) write(X)

Consider two schedules S1 and S2, such that D1 and D2 are read operation of transaction 1 and transaction 2 respectively. Similarly, E1 and E2 are write operations of transaction 1 and 2 respectively. Find out whether the given schedule is conflict serializable or not. Note: Find serializability of S1 and S2 separately. Show every step.

(i) S1 : D1(Z) D2(Z) E2(Z) D2(X) E1(Z) D1(X) E1(X) E2(X)

(ii) S2 : D2(Z) D1(Z) E1(Z) E2(Z) D1(X) E1(X) D2(X) E2(X) *[(CO4)(Analyze/IOCQ)]*

6 + 6 = 12

7. (a) Explain the preemptive and non-preemptive scheme of deadlock prevention. *[(CO4)(Understand/LOCQ)]*

(b) Consider two transactions T1 and T2 with following database operations:

T1: R1(A) W1(A) R1(B) W1(B)

T2: R2(A) W2(A) R2(C) W2(C)

where, Ri(x) and Wi(x) are read and write operations of Ti on data item x.

Find out whether the following concurrent schedule S1 and S2 are conflict serializable or not – Justify your answer.

(i) S1 = R1(A) R2(A) W2(A) W1(A) R2(B) W2(B) R1(C) W1(C)

(ii) S2 = R2(C) W2(C) R2(B) R1(A) W2(B) W1(A) R1(B) W1(B). *[(CO4)(Analyze/IOCQ)]*

6 + 6 = 12

Group - E

8. (a) Suppose that an ordered file with total records 80000 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.

(ii) To search a record from the file how many block access is required.

Suppose a primary index is created on the above file, with ordering key field 14 bytes and block pointer 8 bytes.

(iii) Find the blocking factor for the index. Also find the total number of blocks in the index.

(iv) Find how many black access is required to access a particular record. *[(CO5,CO6)(Apply/IOCQ)]*

(b) Suppose the above mentioned primary index is converted to multi level index structure. Calculate the (i) Fan out of each level (ii) Calculate the top level index (iii) number of blocks in each level. (iv) To search a record how many block access is required. *[(CO5,CO6)(Evaluate/HOCQ)]*

8 + 4 = 12

9. (a) Consider a database where records of employees and their project-star-date is maintained along with the project duration. Create a B tree on the employees id. The order of internal node is 3. The employee's' id are as follows.

310	77	22	43	12	97	98	2	23	44

[(CO5)(Create/HOCQ)]

(b) What is the difference between primary index and clustering index. Justify for or against the statement "Secondary index is a dense index". *[(CO5)(Understand/LOCQ)]*

6 + (2 + 4) = 12

Cognition Level	*LOCQ*	*IOCQ*	*HOCQ*
Percentage distribution	*17.71*	*51.04*	*31.25*

Course Outcome (CO):

After the completion of the course students will be able to

1. Understand the need of DBMS over traditional file system and acquire the knowledge on overall database description, at three levels, namely, internal, conceptual, and external levels.
2. Deduce the constraints , i.e., the candidate keys, super-keys, that exists in a given real world problem and design the entity relationship diagram to graphically represent entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems.
3. Formulate a mathematical tool using relational algebra that operates on one or more relational tables and outputs a relational table as result, and design a normalized Database based on real-world situations, maintaining all constraints and manipulate database relations using SQL and PL/SQL.
4. Prove whether the ordering of concurrent transactions result in inconsistency of the database system or not.
5. Compare the number of block access required for searching a particular record, in an un indexed data file, with respect to a data file having (primary , secondary , clustering or multilevel) index structure.
6. Create a complete Normalized Database system, maintaining all the requirement specifications for a real life problem, and creating indexed relations for efficient accessing.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*