DATABASE MANAGEMENT SYSTEMS
(INF2203)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following is a characteristic of a weak entity?
(a)It has its own primary key. (b) It depends on a strong entity.
(c) It is independent of other entities. (d) It can have multiple primary keys.

(ii) In relational algebra, the operation that combines tuples from two relations using condition based on common attributes is called:
(a) Union (b) Intersection
(c) Projection (d) Join

(iii) Which of the following operations is NOT part of relational algebra?
(a) Selection (b) Aggregation
(c) Set difference (d)Cross product

(iv) Which of the following statement is true with respect to SQL statement
Statement 1: A where clause cannot accept conditions with alias names
Statement 2: A where clause cannot accept conditions with group functions
Statement 3: A where clause cannot accept conditions involving any subqueries
(a) 1 & 2 only (b) 1 & 3 only
(c) 2 & 3 only (d) All of these

(v) Which functional dependency axiom states that if X -> Y and Y -> Z, then X -> Z?
(a) Reflexivity (b) Augmentation
(c) Transitivity (d) Decomposition

(vi) If a relation has the functional dependencies A -> B, B -> C, and A -> C, what can be said about the closure of attribute A?
(a) {A} (b) {A, B}
(c) {A, C} (d) {A, B, C}

(vii) What is the key difference between 3NF and BCNF?
(a) BCNF allows some transitive dependencies while 3NF does not.
(b) In BCNF, every determinant is a super key, while in 3NF, it's only required that non-prime attributes depend on the key.
(c) 3NF eliminates all forms of redundancy, while BCNF does not.
(d) 3NF allows some functional dependencies where determinants are not super keys, while BCNF does not.

(viii) Which of the following is not a partial functional dependency (FD)?
(a) FD A -> B in a relation where {A, B, C} is a composite primary key.
(b) FD B -> C where B is part of a composite key {A, B} and C is a candidate Key
(c) FD A -> C where A is a non-prime attribute and C is part of the key.
(d) FD A -> D in a relation where A is part of a composite key {A,B} and D is a non-prime attribute.

(ix) Assume transaction T1 only holds a shared lock R. If transaction T2 also requests for shared lock on R
(a) it will result in a deadlock (b) it will immediately be granted
(c) it will immediately be rejected (d) it will be granted as soon as it is released by T1

(x) Consider a B+-tree in which the maximum number of keys in a node is 11. What is the minimum number of keys in any non-root node?
(a) 6 (b) 5 (c) 7 (d) 4

Fill in the blanks with the correct word

(xi) The _____ attribute and primary key of strong entity set acts as the composite primary key of the weak entity set.

(xii) _____ graph is used for checking conflict serializability.

(xiii) A transaction begins after a _____or _____

(xiv) In SQL, the _____ command is used to remove all records from a table without deleting the table itself.

(xv) A _____ entity in an ER diagram is an entity that cannot exist without being associated with another entity.

Group - B

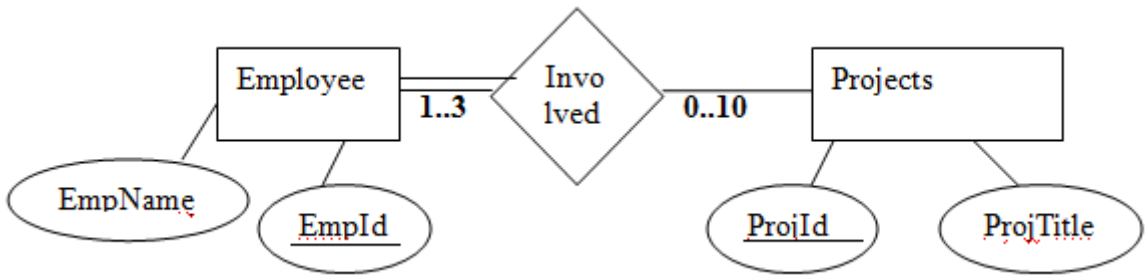
2. (a) Why would you choose database systems instead of file processing systems?

[(CO1) (Understand/LOCQ)]

(b) What is meant by mapping cardinality? Explain with appropriate examples.

[(CO1) (Understand/IOCQ)]

(c) Consider the following entity sets with their relationships, with cardinality.
(i) Describe the cardinality that exists
(ii) State the entity integrity constraint and the referential integrity constraint
(iii) Describe the existing participation of entity set with the relationship set.
(iv) Modify the ERD to add a week entity set
(v) Map the modified ER model to relational model



[(CO2) (Apply/IOCQ)]

3 + 4 + 5 = 12

3. (a) Define the following terms with suitable examples:
(i) Derived attribute
(ii) Many to many mapping.

[(CO1) (Understand/LOCQ)]

(b) Let A (P, Q, X) and B (X,Y, Z) be two relations: Show the outcome of the following relational algebraic expression involving the above relations A and B:
A ⋈B
A ⋉ B
A ⋈B
A ⋊B

A

P	Q	X
p1	q1	x1
p2	q2	x2
p3	q3	x3

B

X	Y	Z
x1	y1	z1
x2	y2	z2
x4	y4	z4

[(CO3) (Apply/IOCQ)]

(2 + 2) + (4 × 2) = 12

Group - C

4. (a) In a banking system there is a relation Employee Customer(employeeId, ename, customerId) which refers to the employee who are also customers of the bank. The constraints that hold on this relation are as follows:
(i) The names of each employee are different from each other i.e. no two employee have same name. That is, both employeeId as well as ename are unique for each entity.
(ii) customerId is also unique for each employee.
List the non-trivial Functional dependencies of this relation. State in which highest normal form this relation exists? Argue in favour or against, that whether this relation can be further normalized to any other normal form or not.

[(CO3, CO6)(Evaluate/HOCQ)]

(b) Consider relation R {ABCDEF} on which the following functional dependencies F are applicable
F = {A → B; BC → D; C → A; B → D; BE → F; CF → D}.
Find candidate keys of R. Show each steps.

[(CO3)(Analyse/IOCQ)]

8 + 4 = 12

5. (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
	I3

Table T2

Internship	Date
I1	24-Apr-2023
I2	12-Jun-2023
I3	16-Dec-2023

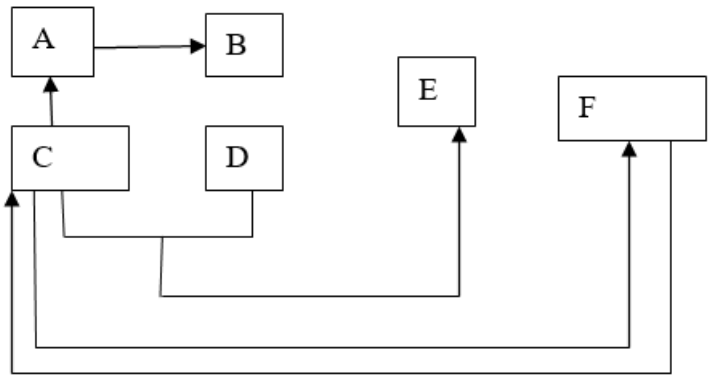
[(CO3) (Apply/IOCQ)]

(b) Write a PL/SQL code to find whether a number entered by the user is even or odd. If even then insert the number in a table named EVEN else insert it into table ODD. Both the tables have only one attribute, number. Repeat the process for all numbers in the range 3 to 100. *[(CO3) (Apply/IOCQ)]*

6 + 6 = 12

Group - D

6. (a) Given a set of functional dependency (FD diagram) that exists in the relation R (A, B, C, D, E,F)



(i) Find the candidate keys of the relation R
(ii) Find out the normal form in which the relation exists
(iii) Convert the relation to its highest normal form possible preserving dependency. All steps must be shown and justified properly. *[(CO3,CO6) (Apply/IOCQ)]*

(b) Find out the canonical cover of the following set of FD's holding on relation R(A, B, C, D, E, F).
(1) F={B→AD, C→D, BD→EF, A->F,B-->F}
(2) F=(A→D, AB->E, DB→F} *[(CO3) (Apply/IOCQ)]*

8 + 4 = 12

7. (a) Consider pet's health history record system, which maintains the data regarding the pet's vaccination. The constraints that exists in the system are as follows.
Every pet has a unique pet-id. Each pet has only a particular name, but two or more pets can have the same name. Every pet-id is associated with a pet-category (i.e., dog, cat…). Pet's age is also maintained and name of the owner is recorded such that an owner may have more than 1 pet. In addition, vaccination-no and vaccination-name is maintained. A vaccination-no is provided against each vaccination name (i.e., if 01 is vaccination-no then name is Rabies Vaccination and vice versa is also true). A particular pet can be given more than one vaccine. A particular vaccine can be associated with more than one pet.
Design the relation with appropriate attributes.

(b) Find out all possible functional dependencies. Find out the candidate keys. Now, convert the relation to BCNF.

(c) Can dependency be preserved. Justify your answer in favour of for or against.

[(CO3,CO6)(Evaluate/HOCQ)]

4 + 6 + 2 = 12

Group - E

8. (a) Consider two transactions T1 and T2 with following database operations:
T_1: $R_1(A)$ $W_1(A)$ $R_1(B)$ $W_1(B)$
T_2: $R_2(A)$ $W_2(A)$ $R_2(C)$ $W_2(C)$
where, $R_i(x)$ and $W_i(x)$ are read and write operations of T_i on data item x.
Find out whether the following concurrent schedule **S** is conflict serializable or not – Justify your answer.
S = $R_1(A)$ $W_1(A)$ $R_2(A)$ $W_2(A)$ $R_1(B)$ $W_1(B)$ $R_2(C)$ $W_2(C)$ *[(CO4) (Analyse/IOCQ)]*

(b) Explain wait-die and wound-wait deadlock prevention scheme. *[(CO4) (Understand/LOCQ)]*

(c) What is starvation. How to prevent it. *[(CO4) (Understand/LOCQ)]*

(d) What is two phase locking protocol. *[(CO4) (Understand/LOCQ)]*

4 + 3 + 2 + 3 = 12

9. (a) Consider a database where records of employees and their projectstar-date is maintained along with the project duration. Create a B tree onthe 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, 65, 210, 344 *[(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	22	51	27