DATABASE MANAGEMENT SYSTEMS
(CSEN 3101)

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) Which of the following relational algebra operations require the participating tables to be union-compatible?
(a) Projection (b) Intersection (c) Cartesian product (d) Join.

(ii) Which of these is not an advantage of database systems?
(a) Data redundancy (b) Data independence
(c) Data security (d) Data abstraction.

(iii) Choose the correct statement from the following:
(a) An alternate key is a candidate key that is not a primary key
(b) An alternate key is a candidate key that is also a primary key
(c) An alternate key is a primary key that is not a candidate key
(d) None of the above.

(iv) Which of the following is not a data integrity constraint?
(a) Unique Constraint (b) Foreign Key Constraint
(c) Check Constraint (d) View Constraint.

(v) A proper decomposition of relation R to relations R1 and R2
(a) may not have a common attribute between R1 and R2
(b) must have one or more common attributes between R1 and R2
(c) may create redundant data in R1 X R2
(d) must create composite attributes in R1 or R2.

(vi) If the precedence graph of a given schedule is acyclic, then the schedule
(a) will always be serializable (b) will never be serializable
(c) may be serializable (d) can't say.

(vii) If the closure of an attribute set is the entire relation, then the attribute set is a
(a) super key (b) candidate key (c) primary key (d) not a key.

(viii) The following may be true if a view V created through CREATE VIEW V statement in SQL:
(a) V can be used as tables in SQL query
(b) V can't be used as tables in SQL query
(c) Data can always be inserted through view V
(d) Data can never be inserted through view V.

(ix) For a relation R(A,B,C,D,E,F) the set of FDs is {A→C, B→D, C→E, D→E, E→A, F→B}. What is the candidate key of R?
(a) A (b) C (c) D (d) F.

(x) Assume transaction A holds a shared lock on R. If transaction B also requests for a shared lock on R, it will
(a) Result in a deadlock situation. (b) Immediately be granted.
(c) Immediately be rejected. (d) Be granted as soon as it is released by A.

Group – B

2. A database is needed for an insurance company to store the following details:
Each employee is represented by employee number, name, address, salary and his/her manager. The company is interested in collecting more data about salesperson. Every salesperson is given a rank (Senior, Middle, Junior etc.). The sales experience (in number of months) of a salesperson is important for the company. The company likes to maintain details of every policy sold by a salesperson. Every policy is identified by its policy number, and the other details are the name of the policy holder, beneficiary and the amount. The database may be used to generate a periodic report showing the business made by every salesperson.
(i) Based on the description above, design an ER diagram for the database. [(CO1) (Understand/LOCQ)]
(ii) Convert the ER design into a set of tables. [(CO3) (Create/IOCQ)]
(iii) Merge and reduce the set of tables without introducing redundancy, if possible. [(CO4) (Analyse and Apply/HOCQ)]

(6 + 4 + 2) = 12

3. (a) Consider the following relations P(A,B,C), Q(A,B,D), R(A,E):

P(ABC)

A1	B1	C1
A2	B1	C2
A3	B3	C2

Q(ABD)

A1	B1	2
A1	B2	5
A2	B1	6
A3	B3	1

R(AE)

A1	E1
A3	E2
A4	E3
A4	NULL

What is the result of the following relational algebra expression?

$$\prod_{ACD}[(\sigma_{(B=B3 \vee C=C2)}[P \bowtie R]) \bowtie (\sigma_{(D>1)}[Q \bowtie R])]$$

Show all intermediate steps in details. [CO2) (Apply/LOCQ)]

(b) Consider the following relational schema for the bank database:
BRANCH(<u>BranchID</u>, Bname, City, Phone)
ACCOUNT(<u>AccountNo</u>, Aname, AType, BranchID, Balance)
TRANSACTION(<u>TID</u>, <u>AccountNo</u>, Amount)
On the basis of this Relational schema, write the following queries in relational algebra.

(i) Retrieve number and type of all accounts located in branch named *Kalikapur*. [(CO2) (Understand/IOCQ)]

(ii) Retrieve the account numbers where every transaction amount is more than Rs. 20000/. [(CO4) (Evaluate/HOCQ)]

5 + (3 + 4) = 12

Group – C

4. Consider the following relational scheme:
BOOKS(Book_Id, B_name, Author, Purchase_date, Cost)
MEMBERS(Member_Id, M_name, Address, Phone)
ISSUE_RETURN(Book_Id, Member_Id, Issue_date, Return_date)
Specify the following queries in SQL.

(i) Find the names, Purchase_date and Cost of all those books that have not been issued. [(CO3) (Understand/LOCQ)]

(ii) Display the Member_ID and the number of books issued to that member. [(CO3) (Analyze/IOCQ)]

(iii) List the books (Book_Id) that have been issued maximum number of times. [(CO3) (Apply/IOCQ)]

(iv) Find the books that have been borrowed by (issued to) only one member. [(CO3) (Evaluate/HOCQ)]

(3 × 4)=12

5. (a) Consider the following two sets of FDs for a relation R(A,B,C,D,E):
F1 = {A->B, B->C, A->C} and F2 = {A->B, B->C, A->D}
Check whether F1 and F2 are equivalent. Justify your answer.
[(CO4) (Analyze/IOCQ)]

(b) Consider the given relation R = (A,B,C,D) with FD set F={AB -> C, BC -> D, CD -> A}
Find out the candidate key(s) of R using attribute closure. Show all intermediate steps. [(CO4) (Apply/LOCQ)]

(c) What is the difference between a HAVING clause and a WHERE clause in SQL? Explain with suitable example. [(CO3) (Remember/LOCQ)]

5 + 3 + 4 = 12

Group – D

6. Consider the relation R(A,B,C,D,E,F,G,H,I,J) having the following set of functional dependencies:
AB → C
A → DE
B→ F
F → GH
D→ IJ

(i) Determine the highest normal form of the relation R. Explain your answer. [(CO4) (Understand/LOCQ)]

(ii) If R is not in 2NF, decompose R into 2NF, and then decompose into 3NF. If R is in 2NF, decompose R into 3NF. Show the steps.

[(CO4) (Analyze/IOCQ)][(CO4) (Apply/IOCQ)]

(iii) Is there a BCNF decomposition of R? Justify your answer. [(CO4) (Evaluate/HOCQ)]

4 + 6 + 2 = 12

7. (a) What do you understand by Multivalued Dependency? What are the conditions for a relation to be in 4NF? [(CO4)(Remember/LOCQ)]

   (b) Let R (A, B, C, D) be a relation with functional dependency {AB –> C, C –> D, D –> A}. Relation R is decomposed into R1(A, B, C) and R2(C, D). Check whether the decomposition is dependency preserving or not. [(CO4)(Apply/IOCQ)]

   (c) Why is BCNF considered to be a stricter normal form than 3NF? Is it possible to decompose a relation in BCNF and preserve all dependencies? Justify your answer. (CO4)(Understand/HOCQ]

4 + 4 + (2 + 2) = 12

Group – E

8. (a) Let T1 and T2 be transactions that operate on same data items X, Y & Z. Let r1(X) mean that T1 reads X, w1(X) mean that T1 writes X, same for T2. Given are two schedules S1& S2.
   S1: r1(X); w1(X); r2(X); w2(X); r1(Y); w1(Y); r2(Z); w2(Z)
   S2: r1(X); r2(X); w2(Y); w2(Y); r1(Y); w1(X)
   Using precedence graphs, determine if they are conflict serializable or not.
   If a schedule is serializable, write down the equivalent serial schedule(s).
   [(CO5) (Analyze/HOCQ)]

   (b) What do you understand by recoverable schedule? Why is it necessary for schedules to be recoverable? Explain with suitable example(s).
   [(CO5)(Understand/LOCQ)]

(6 + 2) + (2 + 2) = 12

9. Write short notes on any FOUR of the following (with examples): **(3 × 4) = 12**
   (i) B-tree
   (ii) Two-phase locking protocol
   (iii) Multivalued dependency
   (iii) Interpretation of Null values
   (iv) Hash file organization
   (v) Natural join in SQL
   [(CO3) (CO4) (CO5) (CO6) (Understand/LOCQ)]
   [(CO3) (CO4) (CO5) (CO6) (Apply/IOCQ)]

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	41%	35%	24%

Course Outcome (CO):

After the completion of the course students will be able to

CSEN3111.1. (CO1) Identify the basic concepts and various data model used in database design. Be able to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.

CSEN3211.1. (CO2) Formulate relational algebra expression for queries and evaluate it using the concept of query processing and optimization.
CSEN3311.1. (CO3) Create RDBMS schema mapping various business validations and formulate queries based on that schema using SQL to satisfy business requirements.
CSEN3411.1. (CO4) Apply normalization and various types of dependencies for evaluating a relational database design.
CSEN3511.1. (CO5) Apply and relate the concept of transaction, concurrency control and recovery in database.
CSEN3611.1. (CO6) Understand with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

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

Department & Section	Submission Link
CSE - A	https://classroom.google.com/c/NDA1Mjc2MTA3NjA5/a/NDYzODQ3NTE5ODc4/details
CSE - B	https://classroom.google.com/c/NDAxMTgwMTE5ODgy/a/NDY0MTc2NzczMTcz/details
CSE - C	https://classroom.google.com/c/NDA1Mzc1OTYyOTQ2/a/NDYzODYxNTAxMTU2/details