Relational Algebra Previous Gate Question

1.	Given the relations employee (name, salary, deptno) and department (deptno, deptname, address) Which of the following queries cannot be expressed using the basic relational algebra operations (U, -, x,∏, σ , p)? (GATE CS 2000) (a) Department address of every employee (b) Employees whose name is the same as their department name (c) The sum of all employees' salaries (d) All employees of a given department **Answer: (c)**
2.	Given relations r(w, x) and s(y, z), the result of select distinct w, x from r, s is guaranteed to be same as r, provided (GATE CS 2000) (A) r has no duplicates and s is non-empty (b) r and s have no duplicates (c) s has no duplicates and r is non-empty (d) r and s have the same number of tuples **Answer: (A)**
3.	Consider the above tables A, B and C. How many tuples does the result of the following SQL query contains? SELECT A.id FROM A WHERE A.age > ALL (SELECT B.age FROM B WHERE B. name = "arun") (A) 4 (B) 3 (C) 0 (D) 1 **Answer: (B)**
4.	Information about a collection of students is given by the relation studinfo (studId, name, sex). The relation enroll(studId, courseId) gives which student has enrolled for (or taken) that course(s). Assume that every course is taken by at least one male and at least one female student. What does the following relational algebra expression represent?

	$\Pi_{\text{courseId}}\left(\left(\Pi_{\text{studId}}\left(\sigma_{sex=\text{"female"}}\left(\text{studInfo}\right)\right)\times\Pi_{\text{courseId}}\left(\text{enroll}\right)\right)-\text{enroll}\right)$ (A) Courses in which all the female students are enrolled. (B) Courses in which a proper subset of female students are enrolled. (C) Courses in which only male students are enrolled. (D) None of the above **Answer: (B)**
5.	Consider the table employee (empId, name, department, salary) and the two queries Q1 ,Q2 below. Assuming that department 5 has more than one employee, and we want to find the employees who get higher salary than anyone in the department 5, which one of the statements is TRUE for any arbitrary employee table? Q1 : Select e.empId From employee e Where not exists (Select * From employee s where s.department = "5" and s.salary >=e.salary) Q2 : Select e.empId From employee e Where e.salary > Any (Select distinct salary From employee s Where s.department = "5") (A) Q1 is the correct query (B) Q2 is the correct query (C) Both Q1 and Q2 produce the same answer. (D) Neither Q1 nor Q2 is the correct query **Answer: (D)**
6.	Consider the relation enrolled (student, course) in which (student, course) is the primary key, and the relation paid (student, amount) where student is the primary key. Assume no null values and no foreign keys or integrity constraints. Given the following four queries: Query1: select student from enrolled where student in (select student from paid) Query2: select student from paid where student in (select student from enrolled) Query3: select E.student from enrolled E, paid P where E.student = P.student Query4: select student from paid where exists (select * from enrolled where enrolled.student = paid.student) Which one of the following statements is correct? (A) All queries return identical row sets for any database (B) Query2 and Query4 return identical row sets for all databases but there exist databases for which Query1 and Query2 return different row sets. (C) There exist databases for which Query3 returns strictly fewer rows than Query2. (D) There exist databases for which Query4 will encounter an integrity violation at runtime. **Answer: (A)**
7.	Let R and S be two relations with the following schema R (P,Q,R1,R2,R3)

	S (P,Q,S1,S2) Where {P, Q} is the key for both schemas. Which of the following queries are equivalent? I. $\Pi_P (R \bowtie S)$ II. $\Pi_P (R) \bowtie \Pi_P (S)$ III. $\Pi_P (\Pi_{P,Q} (R) \cap \Pi_{P,Q} (S))$ IV. $\Pi_P (\Pi_{P,Q} (R) - (\Pi_{P,Q} (R) - \Pi_{P,Q} (S)))$ (A) Only I and II (B) Only I and III (C) Only I, II and III (D) Only I, III and IV **Answer: (D)**
8.	**Database table by name Loan_Records is given below.** Borrower Bank_Manager Loan_Amount Ramesh Sunderajan 10000.00 Suresh Ramgopal 5000.00 Mahesh Sunderajan 7000.00 **What is the output of the following SQL query?** SELECT Count(*) FROM ((SELECT Borrower, Bank_Manager FROM Loan_Records) AS S NATURAL JOIN (SELECT Bank_Manager, Loan_Amount FROM Loan_Records) AS T); (A) 3 (B) 9 (C) 5 (D) 6 **Answer: (C)**
9.	Suppose (A, B) and (C,D) are two relation schemas. Let r1 and r2 be the corresponding relation instances. B is a foreign key that refers to C in r2. If data in r1 and r2 satisfy referential integrity constraints, which of the following is ALWAYS TRUE?

(A) $\Pi_B(r_1) - \Pi_C(r_2) = \varnothing$

(B) $\Pi_C(r_2) - \Pi_B(r_1) = \varnothing$

(C) $\Pi_B(r_1) = \Pi_C(r_2)$

(D) $\Pi_B(r_1) - \Pi_C(r_2) \neq \varnothing$

Answer: (A)

10. What is the optimized version of the relation algebra expression $\pi_{A1}(\pi_{A2}(\sigma_{F1}(\sigma_{F2}(r))))$, where $A1, A2$ are sets of attributes in r with $A1 \subset A2$ and $F1, F2$ are Boolean expressions based on the attributes in r?

GATE 2014

(A) $\pi_{A1}(\sigma_{(F1 \wedge F2)}(r))$

(B) $\pi_{A1}(\sigma_{(F1 \vee F2)}(r))$

(C) $\pi_{A2}(\sigma_{(F1 \wedge F2)}(r))$

(D) $\pi_{A2}(\sigma_{(F1 \vee F2)}(r))$

Answer: (A)

11. What is the **optimized version** of the relation algebra expression

$$\Pi_{A1}(\Pi_{A2}(\sigma_{F1}(\sigma_{F2}(r))))$$

A1 is a subset of A2

F1, F2 are Boolean expressions based on the attributes in r

(A) $\pi_{A1}(\sigma_{(F1 \wedge F2)}(r))$

(B) $\pi_{A1}(\sigma_{(F1 \vee F2)}(r))$

(C) $\pi_{A2}(\sigma_{(F1 \wedge F2)}(r))$

(D) $\pi_{A2}(\sigma_{(F1 \vee F2)}(r))$

Ans = A

$$\Pi_{salary}(\Pi_{ename,\ salary}(\sigma_{eno>10}(\sigma_{gender='M'}(r))))$$

$$= \Pi_{salary}(\sigma_{eno>10}(\sigma_{gender='M'}(r)))$$

$$= \Pi_{salary}(\sigma_{eno>10\ AND\ gender='M'}(r))$$

$$\Pi_{A1}(\Pi_{A2}(\sigma_{F1}(\sigma_{F2}(r)))) = \Pi_{A1}(\sigma_{F1 \wedge F2}(r)))$$

12	Let R1 (A, B, C) and R2 (D, E) be two relation schema, where the primary keys are shown underlined, and let C be a foreign key in R1 referring to R2. Suppose there is no violation of the above referential integrity constraint in the corresponding relation instances r1 and r2. Which one of the following relational algebra expressions would necessarily produce an empty relation? GATE 2004 1) $\Pi_D (r_2) - \Pi_C (r_1)$ 2) $\Pi_C (r_1) - \Pi_D (r_2)$ 3) $\Pi_D (r_1 \bowtie_{C=D} r_2)$ 4) $\Pi_C (r_1 \bowtie_{C=D} r_2)$ **Answer: (B)**
13	**GATE 2012 : 2Marks** Consider the following relations A, B and C:- **A** | Id | Name | Age | | --- | --- | --- | | 12 | Arun | 60 | | 15 | Shreya | 24 | | 99 | Rohit | 11 | **B** | Id | Name | Age | | --- | --- | --- | | 15 | Shreya | 24 | | 25 | Hari | 40 | | 98 | Rohit | 20 | | 99 | Rohit | 11 | **C** | Id | Phone | Area | | --- | --- | --- | | 10 | 2200 | 2 | | 99 | 2100 | 1 | How many tuples does the result of the following relational algebra expression contains? Assume that the schema of AUB is same as that of A. $(A \cup B) \bowtie_{A.Id > 40 \vee C.Id < 15} C$ a) 7 b) 4 c) 5 d) 9 **Answer: (A)**

14	**GATE 2014 Set:3 → 2 Marks** Consider the relational schema given below, where eId of the relation dependent is a foreign key referring to empId of the relation employee. Assume that every employee has at least one associated dependent in the dependent relation. **employee(empId, empName, empAge)** **dependent(depId, eId, depName, depAge)** Consider the following relational algebra query:- $\Pi_{empid}(employee) - \Pi_{empid}(employee \bowtie_{(empid = eid) \wedge (empAge \leq depAge)} dependent)$ The above query evaluates to the set of empIds of employees whose age is greater than that of a) Some dependent b) All dependents c) Some of his/her dependents d) All of his/her dependents **Answer: (D)**

Transaction- Previous Gate Question

1.	Consider the following transaction involving two bank accounts xx and yy. read(x); x:=x-50; write (x); read(y); y:=y+50; write(y) The constraint that the sum of the accounts x and y should remain constant is that of [Gate-2015] A. Atomicity B. Consistency C. Isolation D. Durability **Ans: B**
2.	Consider the following schedules involving the transactions. Which one of the following statements is TRUE ? [GATE 2007 : 2 Marks] S1 : r1(X); r1(Y); r2(X); r2(Y); w2(Y); w1(X) S2: r1(X); r2(X); r2(Y); w2(Y); r1(Y); w1(X) Both S1 and S2 are conflict serializable S1 is conflict serializable and S2 is not conflict serializable S1 is not conflict serializable and S2 is conflict serializable Both S1 and S2 are not conflict serializable **Ans: C**

3. Consider the transactions $T1, T2,$ and $T3$ and the schedules $S1$ and $S2$ given below.

$T1 : r1(X); r1(Z); w1(X); w1(Z)$

$T2 : r2(Y); r2(Z); w2(Z)$

$T3 : r3(Y); r3(X); w3(Y)$

$S1 : r1(X); r3(Y); r3(X); r2(Y); r2(Z); w3(Y); w2(Z); r1(Z); w1(X); w1(Z)$

$S2 : r1(X); r3(Y); r2(Y); r3(X); r1(Z); r2(Z); w3(Y); w1(X); w2(Z); w1(Z)$

Which one of the following statements about the schedules is **TRUE**?

A. Only $S1$ is conflict-serializable.
B. Only $S2$ is conflict-serializable.
C. Both $S1$ and $S2$ are conflict-serializable.
D. Neither $S1$ nor $S2$ is conflict-serializable.

[Gate-2014]
Ans: A

4. Consider the following schedule S of transactions T1, T2, T3, T4:

T1	T2	T3	T4
	Reads(X)		
		Writes(X) Commit	
Writes(X) Commit			
	Writes(Y) Reads(Z) Commit		
			Reads(X) Reads(Y) Commit

Which one of the following statements is CORRECT? [Gate-2014]
(A) S is conflict-serializable but not recoverable
(B) S is not conflict-serializable but is recoverable
(C) S is both conflict-serializable and recoverable
(D) S is neither conflict-serializable nor is it recoverable

Answer: (C)

5. Consider the following four schedules due to three transactions (indicated by the subscript) using read and write on a data item x, denoted by r(x) and w(x) respectively. Which one of them is conflict serializable. [Gate-2014].

	(A) $r_1(x)$; $r_2(x)$; $w_1(x)$; $r_3(x)$; $w_2(x)$ (B) $r_2(x)$; $r_1(x)$; $w_2(x)$; $r_3(x)$; $w_1(x)$ (C) $r_3(x)$; $r_2(x)$; $r_1(x)$; $w_2(x)$; $w_1(x)$ (D) $r_2(x)$; $w_2(x)$; $r_3(x)$; $r_1(x)$; $w_1(x)$ (A) A (B) B (C) C (D) D **Answer: (D)**
6.	Consider the following schedule for transactions T1, T2, and T3:- [GATE 2010 : 2 Marks] <table><tr><th>T1</th><th>T2</th><th>T3</th></tr><tr><td>Read(X)</td><td></td><td></td></tr><tr><td></td><td>Read(Y)</td><td></td></tr><tr><td></td><td></td><td>Read(Y)</td></tr><tr><td></td><td>Write(Y)</td><td></td></tr><tr><td>Write(X)</td><td></td><td></td></tr><tr><td></td><td></td><td>Write(X)</td></tr><tr><td></td><td>Read(X)</td><td></td></tr><tr><td></td><td>Write(X)</td><td></td></tr></table> Which one of the following schedules below is the correct serialization of the above? a) T1 → T3 → T2 b) T2 → T1 → T3 c) T2 → T3 → T1 d) T3 → T1 → T2 **Ans: A**
7.	T1: read (P) ; read (Q) ; if P = 0 then Q : = Q + 1 ; write (Q) ; T2: read (Q) ; read (P) ;

	if Q = 0 then P : = P + 1 ; write (P) ; Any non-serial interleaving of T1 and T2 for concurrent execution leads to (A) A serializable schedule (B) A schedule that is not conflict serializable (C) A conflict serializable schedule (D) A schedule for which a precedence graph cannot be drawn [GATE 2012 : 2 Marks] **Ans: B**
8.	How many view equal serial schedules possible for the following schedule? S : w1(A) r2(A) w3(A) r4(A) w5(A) r6(A) w7(A) r8(A) (A)1 (B)4 (C)6 (D)8 **Ans: c**

FD Previous Gate Questions

1.	Let R= (A, B, C, D, E, F) be a relation scheme with the following dependencies: C->F, E->A, EC->D, A->B. Which of the following is a key for R? GATE-1999 (a) CD (b) EC (c) AE (d) AC **Answers: B**
2.	Given the following relation instance. ------- X Y Z ------- 1 4 2 1 5 3 1 6 3 3 2 2 ------- Which of the following functional dependencies are satisfied by the instance? **GATE-2000** (a) XY -> Z and Z -> Y (b) YZ -> X and Y -> Z (c) YZ -> X and X -> Z (d) XZ -> Y and Y -> X **Answers: B**

3.	From the following instance of a relational schema R(A, B, C), we can conclude that: ---------- A B C ---------- 1 1 1 1 1 0 2 3 2 2 3 2 ---------- **GATE-2002** (A) A functionally determines B and B functionally determines C (b) A functionally determines B and B does not functionally determine C (c) B does not functionally determine C (d) A does not functionally determine B and B does not functionally determine C **Answers: B**
4.	In a schema with attributes A, B, C, D and E, following set of functional dependencies are given: A->B A->C CD->E B->D E->A Which of the following functional dependencies is NOT implied by the above set? (a) CD->AC (b) BD->CD (c) BC->CD (d) AC->BC **GATE-2005(IT)** **Answers: B**
5.	The following functional dependencies are given: $AB \rightarrow CD, AF \rightarrow D, DE \rightarrow F, C \rightarrow G, F \rightarrow E, G \rightarrow A$ Which one of the following options is false? (A)CF+ = {ACDEFG} (B)BG+ = {ABCDG} (C)AF+ = {ACDEFG} (D)AB+ = {ABCDFG} GATE 2005(IT) **Answers: C & D**
6.	Consider a relation scheme R = (A, B, C, D, E, H) on which the following functional dependencies hold: {A–>B, BC–>D, E–>C, D–>A}. What are the candidate keys of R? (a) AE, BE (b) AE, BE, DE (c) AEH, BEH, BCH

	(d) AEH, BEH, DEH GATE-2005 **Answers: D**
7.	Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values. F={CH→G, A→BC, B→CFH, E→A, F→EG} is a set of functional dependencies (FDs) so that F + is exactly the set of FDs that hold for R. How many candidate keys does the relation R have? GATE-2013 (a) 3 (b) 4 (c) 5 (d) 6 **Answers: B**
8.	The relation R is (a) in 1NF, but not in 2NF. (b) in 2NF, but not in 3NF. (c) in 3NF, but not in BCNF. (d) in BCNF. **Answers: A**
9.	Given an instance of the STUDENTS relation as shown below: **StudentID** | **StudentName** | **StudentEmail** | **StudentAge** | **CPI** 2345 | Shankar | shankar@math | X | 9.4 1287 | swati | swati@ee | 19 | 9.5 7853 | shankar | shankar@cse | 19 | 9.4 9876 | swati | swati@mech | 18 | 9.3 8765 | ganesh | ganesh@civil | 19 | 8.7 For **(StudentName,StudentAge)** to be a key for this instance,the value X should NOT be equal to _____. GATE 2014 **Answers: 19**
10.	The maximum number of super keys for the relation schema R(E,F,G,H) with E as the key is _____. GATE-2014 **Answers: 8**
11.	Consider the relation scheme R = (E,F, G, H, I, J, K, L, M, N) and the set of functional dependencies {{E, F} → {G}, {F} → {I, J}, {E, H} → {K, L}, {K} → {M}, {L} → {N}} on R. What is the key for R ?

	(A) {E,F} (B) {E,F,H} (C) {E,F,H,K,L} (D) {E} GATE-2014 **Answers: B**
12.	Consider the following two statements:- S1: Every table with two single-valued attributes is in 1NF, 2NF, 3NF, and BCNF S2: AB□C, D□E, E□C is a minimal cover for the set of FD's AB□C, D□E, AB□E, E□C Which one of the following is CORRECT? GATE-2014 a) S1 is TRUE and S2 is FALSE. b) Both S1 and S2 are TRUE. c) S1 is FALSE and S2 is TRUE. d) Both S1 and S2 are FALSE. **Answers: A**
13.	Consider the relation X(P, Q, R, S, T, U) with the following set of functional dependencies F = { {P, R} → {S,T}, {P, S, U} → {Q, R} } Which of the following is the trivial functional dependency in F+ is closure of F? GATE-2015 A {P,R}→{S,T} B {P,R}→{R,T} C {P,S}→{S} D {P,S,U}→{Q} **Answers: C**
14.	The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade. --- A C --- 2 4 3 4 4 3 5 2 7 2 9 5 6 4 --- GATE 2005 The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2, 4) is deleted is: (a) (3,4) and (6,4) (b) (5,2) and (7,2) (c) (5,2), (7,2) and (9,5) (d) (3,4), (4,3) and (6,4) **Ans. C**

Normalization Previous Gate Questions

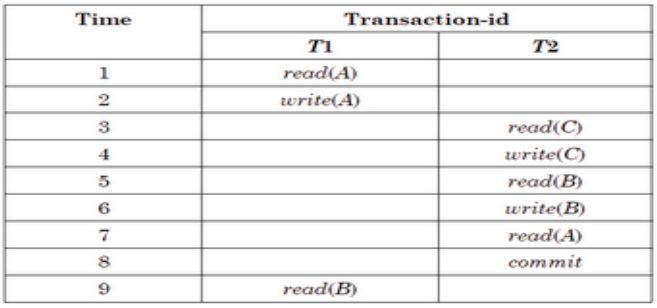
1.	Consider a schema R(A, B, C, D) and functional dependencies A -> B and C -> D. Then the decomposition of R into R1 (A, B) and R2(C, D) is GATE-2001 (a) dependency preserving and lossless join (b) lossless join but not dependency preserving (c) dependency preserving but not lossless join (d) not dependency preserving and not lossless join **Ans. C**
2.	For a database relation R(a,b,c,d), where the domains a,b,c,d include only atomic values, only the following functional dependencies and those that can be inferred from them hold $a \rightarrow c$ $b \rightarrow d$ This relation is GATE-1997 a) IN FIRST NORMAL FORM BUT NOT IN SECOND NORMAL FORM b) IN SECOND NORMAL FORM BUT NOT IN FIRST NORMAL FORM c) IN THIRD NORMAL FORM d) NONE OF THE ABOVE **Ans. A**
3.	A table has fields F1, F2, F3, F4, and F5, with the following functional dependencies: F1->F3 F2->F4 (F1,F2)->F5 in terms of normalization, this table is in GATE-2005 (a) 1NF (b) 2NF (c) 3NF (d) None of these **Ans. A**
4.	Consider the following functional dependencies in a database. Date_of_Birth->Age Age->Eligibility Name->Roll_number Roll_number->Name Course_number->Course_name Course_number->Instructor (Roll_number, Course_number)->Grade The relation (Roll_number, Name, Date_of_birth, Age) is

	GATE-2013 (a) in second normal form but not in third normal form (b) in third normal form but not in BCNF (c) in BCNF (d) in none of the above **Ans. D**
5.	Which of the following is TRUE? GATE-2012 (a) Every relation in 2NF is also in BCNF (b) A relation R is in 3NF if every non-prime attribute of R is fully functionally dependent on every key of R (c) Every relation in BCNF is also in 3NF (d) No relation can be in both BCNF and 3NF **Ans. C**
6.	The relation schema Student_Performance (name, courseNo, rollNo, grade) has the following FDs: name,courseNo->grade rollNo,courseNo->grade name->rollNo rollNo->name The highest normal form of this relation scheme is (a) 2NF (b) 3NF (c) BCNF (d)4NF **Ans. B**
7.	The relation EMPDT1 is defined with attributes empcode(unique), name, street, city, state, and pincode. For any pincode, there is only one city and state. Also, for any given street, city and state, there is just one pincode. In normalization terms EMPDT1 is a relation in GATE-2004 (a) 1NF only (b) 2NF and hence also in 1NF (c) 3NF and hence also in 2NF and 1NF (d) BCNF and hence also in 3NF, 2NF and 1NF **Ans. B**
8.	Let R(A,B,C,D,E,P,G) be a relational schema in which the following FDs are known to hold: AB->CD DE->P

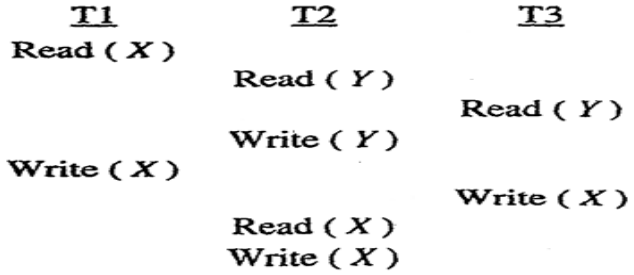
	C->E P->C B->G The relation schema R is GATE-2008 (a) in BCNF (b) in 3NF, but not in BCNF (c) in 2NF, but not in 3NF (d) not in 2NF **Ans. D**
9.	Consider the following relational schemes for a library database: Book (Title, Author, Catalog_no, Publisher, Year, Price) Collection (Title, Author, Catalog_no) With the following functional dependencies: I. Title Author -> Catalog_no II. Catalog_no -> Title Author Publisher Year III. Publisher Title Year -> Price Assume {Author, Title} is the key for both schemes. Which of the following statements is true? GATE-2008 (a) Both Book and Collection are in BCNF (b) Both Book and Collection are in 3NF only (c) Book is in 2NF and Collection is in 3NF (d) Both Book and Collection are in 2NF only **Ans. C**
10.	Which one of the following statements if FALSE? GATE-2007 (A) Any relation with two attributes is in BCNF (b) A relation in which every key has only one attribute is in 2NF (c) A prime attribute can be transitively dependent on a key in a 3 NF relation. (d) A prime attribute can be transitively dependent on a key in a BCNF relation. **Ans. D**
11.	Which one of the following statements about normal forms is FALSE? GATE-2005 (a) BCNF is stricter than 3NF (b) Lossless, dependency-preserving decomposition into 3NF is always possible (c) Lossless, dependency-preserving decomposition into BCNF is always possible (d) Any relation with two attributes is in BCNF

	Ans. C
12.	A prime attribute of a relation scheme R is an attribute that appears [GATE 2014 Set:3] a)In all candidate keys of R. b)In some candidate key of R. c)In a foreign key of R. d)Only in the primary key of R. **Ans. B**

Recovery System Gate Questions

1.	Which of the following scenarios may lead to an irrecoverable error in a database system ? GATE-2003 (A) A transaction writes a data item after it is read by an uncommitted transaction (B) A transaction reads a data item after it is read by an uncommitted transaction (C) A transaction reads a data item after it is written by a committed transaction (D) A transaction reads a data item after it is written by an uncommitted transaction **Ans. D**
2.	Consider the following partial Schedule S involving two transactions T1 and T2. Only the read and the write operations have been shown. The read operation on data item P is denoted by read(P) and the write operation on data item P is denoted by write(P).  GATE-2015 Suppose that the transaction T1 fails immediately after time instance 9. Which one of the following statements is correct? (A) t2 must be aborted and then both t1 and t2 must be re-started to ensure transaction atomicity

Time	Transaction-id	
	$T1$	$T2$
1	$read(A)$	
2	$write(A)$	
3		$read(C)$
4		$write(C)$
5		$read(B)$
6		$write(B)$
7		$read(A)$
8		$commit$
9	$read(B)$	

	(b) schedule s is non-recoverable and cannot ensure transaction atomicity (c) only t2 must be aborted and then re-started to ensure transaction atomicity (d) schedule s is recoverable and can ensure atomicity and nothing else needs to be done **Ans. B**
3.	Consider the following schedule for transactions T1, T2 and T3:  Which one of the schedules below is the correct serialization of the above? GATE-2010 (A) T1->>T3->>T2 (B) T2->>T1->>T3 (C) T2->>T3->>T1 (D) T3->>T1->>T2 **Ans. A**
4.	With respect to the following schedule, which of the following option is true? T1 T2 Lock X(B) Read(B) B=B-50 Write(B) Lock S(A) Read(A) Lock S(B) Lock X(A) (A) deadlock can occur (b) deadlock cannot occur (C) cannot say (d) none of these **Ans. A**

5.	Consider the following log sequence of two transactions on a bank account, with initial balance 12000, that transfer 2000 to a mortgage payment and then apply a 5% interest. 1. T1 start 2. T1 B old=1200 new=10000 3. T1 M old=0 new=2000 4. T1 commit 5. T2 start 6. T2 B old=10000 new=10500 7. T2 commit Suppose the database system crashes just before log record 7 is written. When the system is restarted, which one statement is true of the recovery procedure? GATE-2006 (A) we must redo log record 6 to set B to 10500 (B) we must undo log record 6 to set B to 10000 and then redo log records 2 and 3. (C) we need not redo log records 2 and 3 because transaction t1 has committed. (D) we can apply redo and undo operations in arbitrary order because they are idempotent **Ans. C**
6.	Consider a simple checkpointing protocol and the following set of operations in the log. (start, T4); (write, T4, y, 2, 3); (start, T1); (commit, T4); (write, T1, z, 5, 7); (checkpoint); (start, T2); (write, T2, x, 1, 9); (commit, T2); (start, T3); (write, T3, z, 7, 2); If a crash happens now and the system tries to recover using both undo and redo operations, what are the contents of the undo list and the redo list GATE-2015 (A) Undo: T3, T1; Redo: T2 (B) Undo: T3, T1; Redo: T2, T4 (C) Undo: none; Redo: T2, T4, T3; T1 (D) Undo: T3, T1, T4; Redo: T2 **Ans. A**

Additional Questions

<table>
<tr><td colspan="2">Level-I Questions</td></tr>
<tr><td>1.</td><td>Consider the 2 tables in a relational database with columns and rows as follows
[GATE 2004 IT : 1 Mark]
STUDENT
<table><tr><th>Roll_no</th><th>Name</th><th>Dept_id</th></tr><tr><td>1</td><td>ABC</td><td>1</td></tr><tr><td>2</td><td>DEF</td><td>1</td></tr><tr><td>3</td><td>GHI</td><td>2</td></tr><tr><td>4</td><td>JKL</td><td>3</td></tr></table>DEPARTMENT
<table><tr><th>Dept_id</th><th>Dept_Name</th></tr><tr><td>1</td><td>A</td></tr><tr><td>2</td><td>B</td></tr><tr><td>3</td><td>C</td></tr></table>Roll_no is the primary key of the Student table
Dept_id is the primary key of the Department
Student.Dept_id is a foreign key from Department.Dept_id

What will happen if we try to execute the following 2 SQL statements ?
1. Update Student set Dept_id = Null where Roll_no = 1;
2. Update Department set Dept_id = Null where Dept_id = 1;

a. Both (I) and (II) will fail
b. (I) will fail but (II) will succeed
c. (I) will succeed but (II) will fail
d. Both (I) and (II) will succeed.</td></tr>
<tr><td>2.</td><td>Let R(a,b,c) and S(d,e,f) be 2 relations in which ‘d’ is the foreign key of S that refers to the primary key of R. Consider the following 4 operations on R and S
[GATE 1997: 1 Mark]
A. Insert into R
B. Insert into S
C. Delete from R
D. Delete from S

Which of the following is true about referential integrity constraint above ?

a. None of these can cause its violation
b. All of these can cause its violation
c. Both A and D can cause its violation
d. Both B and C can cause its violation</td></tr>
<tr><td>3.</td><td>The following table has 2 attributes A and C, where A is the primary key and C is the foreign key referencing A with on-delete cascade.
[GATE 2005 : 2 Marks]</td></tr>
</table>

A	C
2	4
3	4
4	3
5	2
7	2
9	5
6	4

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2, 4) is deleted is:-

a. (3 ,4) and (6, 4)
b. (5, 2) and (7, 2)
c. (5, 2), (7, 2) and (9, 5)
d. (3, 4), (4, 3) and (6, 4)

4. Answer the following Question: - [GATE 2014 SET:2→ 1 Mark]

Q.22 Given an instance of the STUDENTS relation as shown below:

StudentID	*StudentName*	*StudentEmail*	*StudentAge*	*CPI*
2345	Shankar	shankar@math	X	9.4
1287	Swati	swati@ee	19	9.5
7853	Shankar	shankar@cse	19	9.4
9876	Swati	swati@mech	18	9.3
8765	Ganesh	ganesh@civil	19	8.7

For ***(StudentName, StudentAge)*** to be a key for this instance, the value X should NOT be equal to _____.

5. Answer the following Question:- [GATE 2014 SET:1→ 1 Mark]

	Q.22 Given the following statements:
	
	S1: A foreign key declaration can always be replaced by an equivalent check assertion in SQL.
	
	S2: Given the table `R(a,b,c)` where `a` and `b` together form the primary key, the following is a valid table definition.
	`CREATE TABLE S (`
	`a INTEGER,`
	`d INTEGER,`
	`e INTEGER,`
	`PRIMARY KEY (d),`
	`FOREIGN KEY (a) references R)`
	
	Which one of the following statements is **CORRECT**?
	
	(A) S1 is TRUE and S2 is FALSE.
	
	(B) Both S1 and S2 are TRUE.
	
	(C) S1 is FALSE and S2 is TRUE.
	
	(D) Both S1 and S2 are FALSE.

6.	Consider the following database schema of relation Employee(Emp#, Name, Age) The following SQL query will return SELECT * FROM Employee WHERE Age <= 28 OR Age >28; a. Tuples of Employee relation with non-NULL age b. Tuples of Employee relation with Age > 28 c. Tuples of Employee relation with Age <=28 d. Copy of Employee relation
7.	The following SQL statement Prints SELECT SUBSTR ('123456789', INSTR('abcabcabc','b'), 4) FROM DUAL; a.456789 b.1234 c.2345 d.6789
8.	A table T1 in a relational database has the following rows and columns: - [GATE 2004 IT: 2 Marks] The following sequence of SQL statements was successfully executed on table T1. Update T1 set marks = marks + 5; Select avg(marks) from T1; What is the output of the select statement?

	a.8.75 b.20 c.25 d.Null
9.	Like 'Amit\%shah%' ESCAPE '\' matches a. Gives error b. All strings beginning with "Amit\%shah" c. All strings beginning with "Amit%shah" d. All strings beginning with "Amit shah
10.	Which of the following statements are equivalent I. LIKE '_ _ _ %' II. LIKE '%_ _ _' III. LIKE '%_ _ %' IV. LIKE '%_ _ _ %' V. LIKE '%_% _% _ %' a. I, II, III, IV and V b. I, II, III and IV c. I, II, IV, and V d. I and II only
11.	Consider the following relations:- Employee(Name, Address, Age) Write a SQL query that gives the names of the employees who share an address. The output should contain minimum no of tuples possible A. SELECT Name FROM Employee WHERE Employee.Address = Employee.Address; B. SELECT E1.Name, E2.Name FROM Employee AS E1, Employee AS E2 WHERE E1.Address = E2.Address AND E1.Name < E2.Name; C. SELECT E1.Name, E2.Name FROM Employee AS E1, Employee AS E2 WHERE E1.Address = E2.Address AND E1.Name <> E2.Name; D. SELECT E1.Name, E2.Name FROM Employee AS E1, Employee AS E2 WHERE E1.Address = E2.Address;
12.	A relational database contains two tables student and department in which student table has columns roll_no, name and dept_id and department table has columns dept_id and dept_name, the following insert statements were executed successfully to populated the empty tables: [GATE 2004 IT : 1 Mark] Insert into department values(1, 'Mathematics'); Insert into department values(2, 'Physics'); Insert into student values (1, 'Navin',1); Insert into student values (2, 'Mukesh', 2);

	Insert into student values (3, 'Gita',1); How many rows and columns will be retrieved by the following SQL statement? Select * from student, department; a. 0 row and 4 columns b. 3 rows and 4 columns c. 3 rows and 5 columns d. 6 rows and 5 columns
13.	Table Employee has 10 records. It has a non-null SALARY column which is also UNIQUE. The following SQL statement Prints SELECT count(*) FROM employee WHERE salary > ANY (SELECT salary FROM employee); a. 0 b. 5 c. 9 d. 10
14.	Consider the following relations A, B and C:- [GATE 2012: 2 Marks] Relation : **A** **Id** **Name** **Age** 12 Arun 60 15 Shreya 24 99 Rohit 11 Relation : **B** **Id** **Name** **Age** 15 Shreya 24 25 Hari 40 98 Rohit 20 99 Rohit 11 Relation : **C** **Id** **Phone** **Age** 10 2200 02 99 2100 01 How many tuples does the result of the following SQL query contain? SELECT A.Id FROM A WHERE A.age > ALL (SELECT B.Age FROM B WHERE B.Name = 'Arun'); a) 4 b) 3 c) 0 d) 1
15.	The employee information in a company is stored in the relation [GATE 2004 : 2 Marks] Employee(name, sex, salary, deptName) Consider the following SQL query SELECT deptName FROM Employee

	WHERE Sex = 'M' GROUP BY deptName HAVING avg(salary) > (SELECT avg(salary) FROM Employee); It returns the names of the department in which a. The average salary is more than the average salary in the company b. The average salary of male employees is more than the average salary of all male employees in the company c. The average salary of male employees is more than the average salary of employees in the same department. d. The average salary of male employees is more than the average salary in the company.
16.	The relation book (title, price) contains the title and prices of different books. Assuming that no two books have the same price, what does the following SQL query list ? [GATE 2005 : 2 Marks] Select title From book as B Where (Select count(*) From book as T Where T.price > B.price) < 5 a. Titles of the 4 most expensive books b. Tile of the 5th most inexpensive book c. Title of the 5th most expensive book d. Titles of the 5 most expensive books
17.	In SQL, GRANT command is used to a. Choose auditing for specific SQL commands b. Grant system privileges, roles and object privileges to users and roles c. Allow user to create databases d. Allow user to access databases
18.	Which of the following statements are true? I. In SQL, We can create virtual tables II. SQL is only Data Manipulation Language III. WHERE clause applies to output of a GROUP BY command IV. HAVING clause applies to columns and expressions for individual rows a. I, III, IV b. I c. All of the above d. I, II, III
LEVEL-II GATE QUESTIONS	
1.	Which of the following is/are correct? [GATE 1999 : 2 Marks] a. An SQL query automatically eliminates duplicates b. An SQL query will not work if there are no indexes on the relations c. SQL permits attribute names to be repeated in the same relation d. None of the above

2.	Consider the join of a relation R with relation S. If R has m-tuples and S has n-tuples then the maximum and minimum sizes of join respectively are [GATE 1999: 1 Mark] a) (m + n) and 0 b) mn and 0 c) (m + n) and |m – n| d) mn and (m + n)
3.	Consider the following relation schema pertaining to a student's database: [GATE 2004 : 1 Mark] Student (rollno, name, address) Enroll (rollno, courseno, coursename) Where the primary keys are shown underlined. The number of tuples in the student and Enroll tables are 120 and 8 respectively. What are the maximum and minimum number of tuples that can be present in (Student*Enroll), where '*' denotes natural join? a) 8,8 b) 120, 8 c) 960,8 d) 960, 120
4.	Which of the following statements are TRUE about an SQL query? [GATE 2012: 1 Mark] P : An SQL query can contain a HAVING clause even if it does not have a GROUP BY clause Q : An SQL query can contain a HAVING clause only if it has a GROUP BY clause R : All attributes used in the GROUP BY clause must appear in the SELECT clause S : Not all attributes used in the GROUP BY clause need to appear in the SELECT clause a) P and R b) P and S c) Q and R d) Q and S
5.	Consider a database table T containing two columns X and Y each of type integer. After the creation of the table, one record (X=1, Y=1) is inserted in the table. [GATE 2011 : 2 Marks] Let MX and MY denote the respective maximum values of X and Y among all records in the table at any point in time. Using MX and MY, new records are inserted in the table 128 times with X and Y values being MX+1, 2*MY+1 respectively. It may be noted that each time after the insertion, values of MX and MY change. What will be the output of the following SQL query after the steps mentioned above are carried out? SELECT Y FROM T WHERE X=7; a) 127

b) 255
c) 129
d) 257

6. Database table by name Loan_Records is given below.
[GATE 2011: 2 Marks]

Borrower Bank_Manager Loan_Amount
Ramesh Sunderajan 10000.00
Suresh Ramgopal 5000.00
Mahesh Sunderajan 7000.00

What is the output of the following SQL query?

```
SELECT Count(*)
FROM  (
          (SELECT Borrower, Bank_Manager
           FROM   Loan_Records) AS S
              NATURAL JOIN
          (SELECT Bank_Manager,Loan_Amount
           FROM   Loan_Records) AS T
       );
```

a) 3
b) 9
c) 5
d) 6

7. A relational schema for a train reservation database is given below. [GATE 2010 : 2 Marks]
Passenger (pid, pname, age)
Reservation (pid, class, tid)

Table: Passenger

pid	pname	Age
0	Sachin	65
1	Rahul	66
2	Sourav	67
3	Anil	69

Table: Reservation

pid	class	Tid
0	AC	8200
1	AC	8201
2	SC	8201

5	AC	8203
1	SC	8204
3	AC	8202

What pids are returned by the following SQL query for the above instance of the tables?

```
SELECT    pid
FROM      Reservation
WHERE     class = 'AC'
 AND      EXISTS (SELECT    *
                  FROM      Passenger
                      WHERE     age > 65
                      AND       Passenger. pid = Reservation.pid)
```

a) 1, 0
b) 1, 2
c) 1, 3
d) 1, 5

8. Consider a database with 3 relation instances shown below. The primary keys for the Drivers and Cards relation are did and cid respectively. [GATE IT 2006 : 2 Marks]

D : Drivers relation

did	dname	rating	age
22	Karthikeyan	7	25
29	Salman	1	33
31	Boris	8	55
32	Amoldt	8	25
58	Schumacher	10	35
64	Sachin	7	35
71	Senna	10	16
74	Sachin	9	35
85	Rahul	3	25
95	Ralph	3	53

R : Reserves relation

did	cid	day
22	101	10/10/06
22	102	10/10/06
22	103	08/10/06
22	104	07/10/06
31	102	10/11/06
31	103	06/11/06
31	104	12/11/06
64	101	05/09/06
64	102	08/09/06
74	103	08/09/06

C : Cars relation

cid	cname	colo
101	Renault	blu
102	Renault	red
103	Ferrari	gree
104	Jaguar	red

What is the output of the following query?

```
SELECT      D.dname
FROM        Drivers D
WHERE       D.did IN ( SELECT     R.did
    FROM    Cars C, Reserves R
                    WHERE       R.cid = C.cid AND C.colour = 'red'
                INTERSECT
     SELECT R.did
     FROM   Cars C, Reservers R
                    WHERE       R.cid = C.cid AND C.colour = 'green');
```

a) Karthikeyan, Boris
b) Sachin, Salman
c) Karthikeyan, Boris, Sachin
d) Schumacher, Senna

9. Answer the following Question:- [GATE 2014 SET:1 → 2 Marks]

Q.54 Given the following schema:

```
employees(emp-id, first-name, last-name, hire-date,
          dept-id, salary)
departments(dept-id, dept-name, manager-id, location-id)
```

You want to display the last names and hire dates of all latest hires in their respective departments in the location ID 1700. You issue the following query:

```
SQL>SELECT last-name, hire-date
    FROM employees
    WHERE (dept-id, hire-date) IN
    (SELECT dept-id, MAX(hire-date)
    FROM employees JOIN departments USING(dept-id)
    WHERE location-id = 1700
    GROUP BY dept-id);
```

What is the outcome?

(A) It executes but does not give the correct result.

(B) It executes and gives the correct result.

(C) It generates an error because of pairwise comparison.

(D) It generates an error because the GROUP BY clause cannot be used with table joins in a sub-query.

10 Answer the following Question:- [GATE 2014 SET:2 → 2 Marks]

Q.54 SQL allows duplicate tuples in relations, and correspondingly defines the multiplicity of tuples in the result of joins. Which one of the following queries always gives the same answer as the nested query shown below:

```
select * from R where a in (select S.a from S)
```

(A)
```
select R.* from R, S where R.a=S.a
```

(B)
```
select distinct R.* from R,S where R.a=S.a
```

(C)
```
select R.* from R,(select distinct a from S) as S1 where
     R.a=S1.a
```

(D)
```
select R.* from R,S where R.a=S.a and is unique R
```

11 Answer the following Question:- [GATE 2014 SET:3 → 2 Marks]

Q.54 Consider the following relational schema:

```
employee(empId,empName,empDept)
customer(custId,custName,salesRepId,rating)
```

salesRepId is a foreign key referring to **empId** of the employee relation. Assume that each employee makes a sale to at least one customer. What does the following query return?

```
SELECT empName
FROM employee E
WHERE NOT EXISTS (SELECT custId
                  FROM customer C
                  WHERE C.salesRepId = E.empId
                  AND C.rating <> 'GOOD');
```

(A) Names of all the employees with at least one of their customers having a 'GOOD' rating.

(B) Names of all the employees with at most one of their customers having a 'GOOD' rating.

(C) Names of all the employees with none of their customers having a 'GOOD' rating.

(D) Names of all the employees with all their customers having a 'GOOD' rating.

12 Consider the following relational schema: [GATE 2009: 2 Marks]

Suppliers(sid:integer, sname:string, city:string, street:string)
Parts(pid:integer, pname:string, color:string)
Catalog(sid:integer, pid:integer, cost:real)
Consider the following relational query on the above database:

```
SELECT      S.sname
FROM  Suppliers S
WHERE       S.sid NOT IN (SELECT C.sid
                          FROM Catalog C
                          WHERE C.pid NOT IN (SELECT P.pid
                                              FROM Parts P
                                              WHERE P.color<> 'blue'))
```

Assume that relations corresponding to the above schema are not empty. Which one of the following is the correct interpretation of the above query?

a) Find the names of all suppliers who have supplied a non-blue part.
b) Find the names of all suppliers who have not supplied a non-blue part.
c) Find the names of all suppliers who have supplied only blue parts.
d) Find the names of all suppliers who have not supplied only blue parts.

13 In an inventory management system implemented at a trading corporation, there are several tables designed to hold all the information. Amongst these, the following 2 tables hold information on which items are supplied by which suppliers, and which warehouse keeps which items along with the stock-level of these items. [GATE IT 2005: 2 Marks]

Supply = (supplierid, itemcode)
Inventory = (itemcode, warehouse, stocklevel)

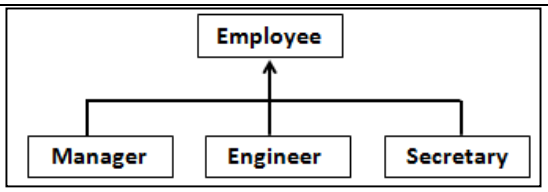
	For a specific information required by the management, following SQL query has been written. SELECT distinct STMP.supplierid FROM supply as STMP WHERE not unique (SELECT ITMP.supplierid FROM inventory, supply as ITMP WHERE ITMP.supplierid = STMP.supplierid AND ITMP.itemcode = Inventory.itemcode AND inventory.warehouse = 'Nagpur'); For the warehouse at Nagpur, this query will find all suppliers who a) do not supply any item b) Supply exactly one item c) supply one (or) more items d) supply 2 (or) more items
14	A company maintains records of sales made by its salespersons and pays them commission based on each individual's total sales made in a year. This data is maintained in a table with following scheme:- Salesinfo = (salespersonid, totalsales, commission) In certain year, due to better business results, the company decides to further reward its sales persons by enhancing the commission paid to them as per the following formula. If commisison < = 50000, enhance it by 2% If 50000 < commission <= 100000, enhance it by 4% If commission > 100000, enhance it by 6% The IT staff has written 3 different SQL scripts to calculate enhancement for each slab. Each of these scripts is to run as a separate transaction as follows:- [GATE 2005 IT : 2 Marks] T1:- Update salesinfo Set commission = commission * 1.02 Where commission < = 50000; T2:- Update salesinfo Set commission = commission * 1.04 Where commission > 50000 and commission <= 100000; T3:- Update salesinfo Set commission = commission * 1.06 Where commission > 100000; Which of the following options of running these transactions will update the commission of all salespersons correctly ? a. Execute T1 followed by T2 followed by T3 b. Execute T2, followed by T3; T1 running concurrently throughout c. Execute T3 followed by T2; T1 running concurrently throughout d. Execute T3 followed by T2 followed by T1
RELATIONAL ALGEBRA AND CALCULUS	

1.	Consider the following SQL query [GATE 2003 : 1 Mark] SELECT distinct a1,a2, ……,an FROM r1,r2,…..,rm WHERE P For an arbitrary predicate P, this query is equivalent to which of the following relational algebra expressions ? a. Π (a1,a2, ……,an) σP(r1×r2×…..×rm) b. Π (a1,a2, ……,an)σP(r1 r2 ….. rm) c. Π (a1,a2, ……,an)σP(r1 r2 ….. rm) d. Π(a1,a2, ……,an)σP(r1 ∩r2∩…..∩rm)
2.	Answer the following Question:- [GATE 2014 SET:3 → 1 Marks] What is the optimized version of the relation algebra expression $\pi_{A1}(\pi_{A2}(\sigma_{F1}(\sigma_{F2}(r))))$, where $A1, A2$ are sets of attributes in r with $A1 \subset A2$ and $F1, F2$ are Boolean expressions based on the attributes in r? (A) $\pi_{A1}(\sigma_{(F1 \wedge F2)}(r))$ (B) $\pi_{A1}(\sigma_{(F1 \vee F2)}(r))$ (C) $\pi_{A2}(\sigma_{(F1 \wedge F2)}(r))$ (D) $\pi_{A2}(\sigma_{(F1 \vee F2)}(r))$
3.	Consider the relation r1(P,Q,R) and r2(R,S,T) with primary keys P and R respectively. The relation r1 contains 2000 tuples and r2 contains 2500 tuples. The maximum size of join r1 r2 a. 2000 b.2500 c.4500 d.5000 [GATE IT 2006 : 1 Mark]
4.	Consider the join of a relation R with relation S. If R has m-tuples and S has n-tuples. Then the maximum and minimum sizes of the join respectively are [GATE 1999: 1 Mark] a.mn and (m + n) b.(m + n) and |m - n| c.mn and 0 d.(m + n) and 0
5.	Consider the following:- (r1 ÷ r2) gives Relation: r1 Process | Time P | 4 Q | 5 Q | 3 P | 3 R | 4 Relation: r2 Time 3 4 (a) Process P Q R (b) Process | Time P | 4 Q | 3 P | 3 R | 4 (c) Process | Time P | 3 P | 4 (d) None

6.	Which of the following query transformations (i.e., replacing the L.H.S expression by the R.H.S expression) is incorrect ? R1 and R2 are relations, C1 and C2 are selection conditions and A1 and A2 are attributes of R1. (a) $\sigma_{c1}(\sigma_{c2}(R_1)) \rightarrow \sigma_{c2}(\sigma_{c1}(R_1))$ **[GATE 1998 : 2 Marks]** (b) $\sigma_{c1}(\pi_{A1}(R_1)) \rightarrow \pi_{A1}(\sigma_{c1}(R_1))$ (c) $\sigma_{c1}(R_1 \cup R_2) \rightarrow \sigma_{c1}(R_1) \cup \sigma_{c1}(R_2)$ (d) $\pi_{A1}(\sigma_{c1}(R_1)) \rightarrow \sigma_{c1}(\pi_{A1}(R_1))$
7.	Given the relations employee(name, salary, deptno) and department(deptno, deptname, address).Which of the following queries cannot be expressed using the basic relational algebra operators (σ,π,×, , ∩ , U,-) ? a. Department address of every employee [GATE 2000 : 1 Mark] b. Employees whose name is the same as their department name c. The sum of all employees salaries d. All employees of a given department
8.	Consider the relational schema given below, where eId of the relation dependent is a foreign key referring to empId of the relation employee. Assume that every employee has at least one associated dependent in the dependent relation. [GATE 2014 Set:3 ? 2 Marks] employee(empId, empName, empAge) dependent(depId, eId, depName, depAge) Consider the following relational algebra query:- The above query evaluates to the set of empIds of employees whose age is greater than that of a) Some dependent b) All dependents c) Some of his/her dependents d) All of his/her dependents
9.	Let r and s be 2 relations over the relation schemes R and S respectively, and let A be an attribute in R. Then the relational algebra expression σA=a (r s) is always equal to [GATE 2001 : 2 Marks] a. σA=a (r) b. r c. σA=a (r) s d. None of the above
10	Let R1(A,B,C) and R2(D,E) be 2 relations schemas, where the primary keys are showed underlined, and let C be a foreign key in R1 referring to R2. Suppose there's is no violation on the above referential integrity constraint in the corresponding relation instances r1 and r2. Which one of the following relational algebra expressions

	would necessarily produce an empty relation. [GATE 2004 : 1 Mark] a. πD (r2) - πC (r2) b. πC (r1) - πD (r2) c. πD (r1 C≠D r2) d. πC (r1 C=D r2)
11	Suppose (A, B) and (C,D) are two relation schemas. Let r1 and r2 be the corresponding relation instances. B is a foreign key that refers to C in r2. If data in r1 and r2 satisfy referential integrity constraints, which of the following is ALWAYS TRUE? [GATE 2012 : 2Marks] (A) $\Pi_B(r_1) - \Pi_C(r_2) = \varnothing$ (B) $\Pi_C(r_2) - \Pi_B(r_1) = \varnothing$ (C) $\Pi_B(r_1) = \Pi_C(r_2)$ (D) $\Pi_B(r_1) - \Pi_C(r_2) \neq \varnothing$
12	Consider the following relations A, B and C:- [GATE 2012 : 2Marks] **A** **Id** **Name** **Age** 12 Arun 60 15 Shreya 24 99 Rohit 11 **B** **Id** **Name** **Age** 15 Shreya 24 25 Hari 40 98 Rohit 20 99 Rohit 11 **C** **Id** **Phone** **Area** 10 2200 02 99 2100 01 How many tuples does the result of the following relational algebra expression contain? Assume that the schema of A∪B is the same as that of A. $(A \cup B) \bowtie_{A.Id > 40 \vee C.Id < 15} C$ (A) 7 (B) 4 (C) 5 (D) 9
13	Consider the relation Student (<u>name</u>, sex, marks), where the primary key is shown underlined, pertaining to students in a class the has at least one boy and one girl. What does the following relational algebra expression produce ? **[GATE 2004 : 2 Marks]** $\Pi_{name}(\sigma_{sex = female}(Student)) - \Pi_{name}(Student \bowtie_{(sex = female \wedge x = male \wedge marks \leq m)} \rho_{n, x, m}(Student))$ a) names of girl students with the highest marks b) names of girl students with more marks than some boy student c) names of girl students with marks not less than some boy student d) names of girl students with more marks than all the boy students
14	14. Consider a selection of the form σA< 100(r), where r is a relation with 1000 tuples. Assume that the attribute values for A among the tuples are uniformly distributed in the interval [0, 500]. Which one of the following options is the best estimate of the number of tuples returned in the given selection query?

	a) 50 b) 100 c) 150 d) 200 [GATE IT 2007 : 1 Mark]
15	A table "student" with schema (roll, name, hostel, marks) and another table "hobby" with schema (roll, hobbyname) contains records as shown below:- [GATE 2005 IT : 2 Marks] The following SQL query is executed on the above tables:- SELECT hostel FROM student NATURAL JOIN hobby WHERE marks > = 75 AND roll BETWEEN 2000 AND 3000; Relations "S and H" with the same schema as those of these two tables respectively contain the same information as tuples. A new relation S1 is obtained by the following relational algebra operation: The difference between the number of rows output by the SQL statement and the number of tuples in S1 is:- a) 6 b) 4 c) 2 d) 0
16	The relational algebra expression equivalent to the following tuple calculus expression $\{ t \mid t \in r \wedge (t[A] = 10 \wedge t[B] = 20)\}$ is [GATE 1999 : 1 Mark] a. $\sigma(A=10 \cup B=20) (R)$ b. $\sigma(A=10) (R) \cup \sigma(B=20) (R)$ c. $\sigma(A=10) (R) \cap \sigma(B=20) (R)$ d. $\sigma(A=10) (R) - \sigma(B=20) (R)$
E-R Model & Relational Model	
1.	Let E1 and E2 be 2 entities in an E-R diagram with simple single-valued attributes. R1 and R2 are 2 relationships between E1 and E2, where R1 is one-to-many and R2 is many-to-many. R1 and R2 don't have any attributes of their own. What is the minimum no of tables required to represent this situation in the relational model? [GATE 2005: 2 Marks] a.2 b.3 c.4 d.5
2.	It is desired to design an object-oriented employee record system for a company. Each employee has a name, unique id and salary. Employees belong to different categories and their salary is determined by their category. The functions getName, getId and getSalary are required. Given the class hierarchy below, possible locations for these functions are [GATE 2005 : 2 Marks]



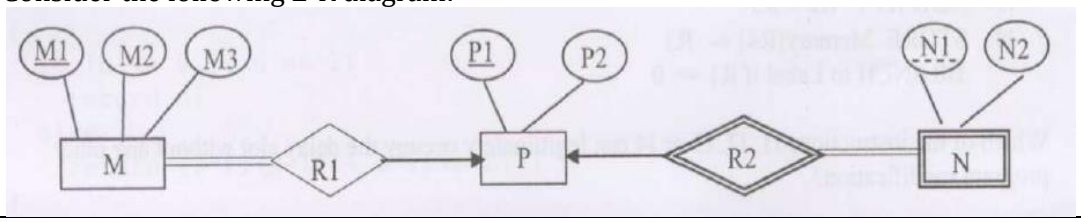
i. getId is implemented in the super class
ii. getId is implemented in the subclass
iii. getName is an abstract function in the super class
iv. getName is implemented in the super class
v. getName is implemented in the subclass
vi. getSalary is an abstract function in the super class
vii. getSalary is implemented in the super class
viii. getSalary is implemented in the subclass.

Choose the best design:-

a. I, IV, VI, VIII b. I,IV,VII c. I,III,V,VI,VIII d.II,V,VIII

COMMON DATA QUESTIONS [GATE 2008 : 4 Marks]

Consider the following E-R diagram:-



3. The minimum number of tables needed to represent M, N, P, R1, R2 are:-
a. 2
b. 3
c. 4
d. 5

4. Which of the following is a correct attribute set for one of the tables for the correct answer to the above question?
a. {M1, M2, M3, P1}
b. {M1, P1, N1, N2}
c. {M1, P1, N1}
d. {M1, P1}

5. Consider the entities "hotel room" and "person" with a many-to-many relationship "lodging" between the entities. If we wish to store information about the "rent payment" to be made by person occupying different hotel rooms, then this information should appear as an attribute of [GATE 2005 IT : 1 Mark]
a. Person
b. Hotel Room
c. Lodging
d. None

SCHEMA REFINEMENT

1. The maximum number of super keys for the relation schema R(E, F, G, H) with E as the key is _____ [GATE 2014 Set:2 → 1 Mark]

2. A prime attribute of a relation scheme R is an attribute that appears [GATE 2014 Set:3 ⍰ 1 Mark]
a) In all candidate keys of R.

b) In some candidate key of R.
c) In a foreign key of R.
d) Only in the primary key of R.

3. Consider the relation scheme R=(E, F, G, H, I, J, K, L, M, N) and the given set of functional dependencies
{EF□G, F□IJ, EH□KL, K□M, L□N} on R. What is the key for R? [GATE 2014 Set:1 □ 1 Mark]
a) {E,F}
b) {E, F, H}
c) {E, F, H, K, L}
d) {E}

4. Consider the following two statements:- [GATE 2014 Set:1 □ 2 Marks]
S1 : Every table with two single-valued attributes is in 1NF, 2NF, 3NF, and BCNF
S2 : AB□C, D□E, E□C is a minimal cover for the set of FD's AB□C, D□E, AB□E, E□C
Which one of the following is CORRECT?
a) S1 is TRUE and S2 is FALSE.
b) Both S1 and S2 are TRUE.
c) S1 is FALSE and S2 is TRUE.
d) Both S1 and S2 are FALSE.

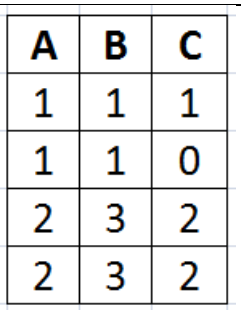
5. Let R = (A, B, C, D, E, F) be a relation scheme with the following dependencies C□F, E□A, EC□D, A□B. Which of the following is a key for R? [GATE 1999 : 1 Mark]
a) CD
b) EC
c) AE
d) AC

6. Given the following relation instant [GATE 2000 : 2 Marks]

P	Q	R
1	4	2
1	5	3
1	6	3
3	2	2

Which of the following functional dependencies are satisfied by the instance?
a. PR à Q and Q à P
b. QR à P and P à R
c. QR à P and Q à R
d. PQ à R and R à Q

7. From following instance of a relation scheme R(A, B, C). we can conclude that [GATE 2002 : 2 Marks]

	 a) "A" functionally determines "B" and "B" functionally determines "C" b) "A" functionally determines "B" and "B" does not functionally determines "C" c) "B" does not functionally determines "C" d) "A" does not functionally determines "B" and "B" does not functionally determines "C"
8.	For a database relation R(a,b,c,d), where the domains of a,b,c,d include only atomic values, only the following functional dependencies and those that can be inferred from them hold: a □ c and b □ d the relation is [GATE 1997 : 2 Marks] a. In 1NF but not in 2NF b. In 2NF but not in 3NF c. In 3NF d. None of the above
9.	Which of the normal form is considered adequate for normal relational database design? a.2NF b.5NF c.4NF d.3NF [GATE 1998: 1 Mark]
10	Consider a schema R(A, B, C, D) and functional dependencies A □ B and C □ D. Then the decomposition of R into R1(AB) and R2(CD) is [GATE 2001 : 1 Mark] a. Dependency preserving and lossless join b. Lossless join but not dependency preserving c. Dependency preserving but not lossless join d. Not dependency preserving and not lossless join
11	Relation R with an associated set of functional dependencies F, is decomposed into BCNF. The redundancy (arising out of functional dependencies) in the resulting set of relation is [GATE 2002 : 1 Mark] a. Zero b. More than Zero but less than that of an equivalent 3NF decomposition c. Proportional to the size of F+ d. Indeterminate
12	The highest normal form of STUDENT(Roll_number, Name, Date_of_birth, Age) with FD's Date_of_Birth → Age [GATE 2003 : 2 Marks] Name → Roll_Number Roll_number → Name a. In 2NF but not in 3NF b. In 3NF, but not in BCNF c. In BCNF d. None of the above
13	Which one of the following statements about normal forms is FALSE? [GATE 2005 : 1 Mark] a. BCNF is stricter than 3NF

	b. Loss less, dependency-preserving decomposition into 3NF is always possible c. Loss Less, dependency-preserving decomposition into BCNF is always possible. d. Any relation with 2 attributes is in BCNF
14	Which one of the following statement is FALSE? [GATE 2007 : 2 Marks] a. Any relation with 2 attributes is in BCNF b. A relation in which every key has only 1 attribute is in 2NF c. A prime attribute can be transitively dependent on a key in 3NF relation d. A prime attribute can be transitively dependent on a key in a BCNF relation.
15	State True (or) False. There is always decomposition into BCNF that is both lossless and dependency preserving. [GATE 1994 : 1 Mark]
16	Find the number of candidate keys for relation R(ABCDE) with FD set F={A→C, AB→D, B→D, C→E, E→A, D→B} a)3 b)4 c)5 d)6
17	Relation R is decomposed using a set of functional dependencies F, and relation S is decomposed using another set of functional dependencies G. One decomposition is definitely BCNF, the other is definitely 3NF, but it is not known which is which. To make a guaranteed identification, which one of the following tests should be used on the decomposition? [Assume that the closures of F and G are available] a. Dependency –Preservation b. Lossless – Join [GATE 2002 : 2 Marks] c. BCNF definition d. 3NF definition
18	Consider a relation scheme R=(A, B, C, D, E, H) on which the following functional dependencies hold: {A□B, BC□D, E□C, D□A}. What are the candidate keys of R? [GATE 2005 : 2 Marks] a) AE, BE b) AE, BE, DE c) AEH, BEH, BCH d) AEH, BEH, DEH
19	The relation scheme Student Performance(name, courseNo, rollNo, grade) has the following functional dependencies:- [GATE 2004 : 2 Marks] Name, courseNo → grade RollNo, courseNo → grade name → rollNo rollNo → name The highest normal form of this relation scheme is:- a) 2NF b) 3NF c) BCNF d)4NF
20	The following functional dependencies are given AB → CD, AF → D, DE → F, C → G, F → E, G → A Which one of the following options is false? [GATE 2006 : 2 Marks] a) $\{CF\}^+ = \{ACDEFG\}$ b) $\{BG\}^+ = \{ABCDG\}$ c) $\{AF\}^+ = \{ACDEFG\}$

	d)$\{AB\}^+ = \{ACDFG\}$
21	Consider the following relational schemes for a library database: [GATE 2008 : 2 Marks] Book (Title, Author, Catalog_no, Publisher, Year, Price) Collection (Title, Author, Catalog_no) with the following functional dependencies: I. Title, Author → Catalog_no II. Catalog_no → Title, Author, Publisher, Year III. Publisher, Title, Year → Price Assume {Author, Title} is the key for both schemes. Which of the following statements is true? a) Both Book and Collection are in BCNF b) Both Book and Collection are in 3NF only c) Book is in 2NF and Collection is in 3NF d) Both Book and Collection are in 2NF only
22	The following functional dependencies hold for relations R(A, B, C) and S(B, D, E): B→A, A→C. The relation R contains 200 tuples and the relation S contains 100 tuples. What is the maximum number of tuples possible in the natural join R * S? ["*" denotes Natural Join] [GATE 2010 : 2Marks] a) 100 b) 200 c) 300 d) 2000
23	Which of the following is TRUE? [GATE 2012 : 1 Mark] a) Every relation in 3NF is also in BCNF. b) Relation R is in 3NF if every non-prime attribute of R is fully functionally dependent on every key of R c) Every relation in BCNF is also in 3 NF. d) No relation can be in both BCNF and 3NF.
24	Let R(A, B, C, D) be a relational schema with the following functional dependencies: A→B, B→C, C→D and D→B. The decomposition of R into (A, B), (B, C), (B, D) [GATE 2008 IT : 2 Marks] a) Gives a lossless join, and is dependency preserving. b) Gives a lossless join, but is not dependency preserving. c) Does not give a lossless join, but is dependency preserving. d) Does not give a lossless join and is not dependency preserving.
LINKED QUESTIONS: 28 & 29	
25	How many candidate keys does the relation R have? a) 3 b) 4 c) 5 d) 6
26	The relation R is a) In 1NF, but not in 2NF. b) In 2NF, but not in 3NF. c) In 3NF, but not in BCNF. d) In BCNF.
27	Let R(A, B, C, D, E, P, G) be a relational schema in which the following functional dependencies are known to hold: AB□CD, DE□P, C□E, P□C, and B→G. The relational schema R is [GATE 2008 IT : 2 Marks]

	a)In BCNF. b) In 3NF, but not in BCNF. c)In 2NF, but not in 3NF. d) Not in 2NF.
28	Consider a relation R with five attributes V, W, X, Y, and Z. The following functional dependencies hold : VY→W, WX→Z, and ZY→V. Which of the following is candidate key for R? [GATE 2006 IT : 2 Marks] a) VXZ b) VXY c) VWXY d) VWXYZ
29	In a schema with attributes A, B, C, D and E with the following set of functional dependencies are given:- A→B, A→C, CD→E, B→D, E→A. Which of the following functional dependencies is NOT implied by the above set? [GATE IT 2006 : 2 Marks] a) CD□AC b) BD□CD c) BC□CD d) AC□BC
30	A table has fields F1, F2, F3, F4, F5 with the following functional dependencies F1→F3, F2□→F4, (F1,F2)→F5. In terms of normalization, this table is in [GATE IT 2005: 2 Marks] a) 1NF b) 2NF c) 3NF d) None
31	In the basic ER and relational models, which of the following is INCORRECT? a) An attribute of an entity can have more than one value [GATE 2012 : 1 Mark] b) An attribute of an entity can be composite c) In a row of a relational table, an attribute can have more than one value. d) In a row of a relational table, an attribute can have exactly one value (or) a NULL value.
32	Answer the following Question:- [GATE 2005: 1 Mark] Let r be a relation instance with schema R = (A, B, C, D). We define $r_1 = \Pi_{A,B,C}(R)$ and $r_2 = \Pi_{A,D}(r)$. Let $s = r_1 * r_2$ where * denotes natural join. Given that the decomposition of r into r_1 and r_2 is lossy, which one of the following is TRUE? (a) $s \subset r$ (b) $r \cup s = r$ (c) $r \subset s$ (d) $r * s = s$
33	Consider the E-R diagram where two entries E1 and E2 have a relation R of cardinality 1:m  The attributes of E1 are A11, A12, A13 where A11 is the key attribute.

	The attributes of E2 are A21, A22, A23 where A21 is key attribute and A23 is a multi-value attribute. Relation R does not have any attribute. A relational database containing minimum number of tables with each table satisfying the requirement of 3NF is designed from above ERD. The number of tables in database is [GATE 2004 IT : 2 Marks] a)2 b)3 c)5 d)4

FILE ORGANIZATION & INDEXING	
1.	A clustering index is defined on the field which are of type [GATE 2008 : 1 Mark] a. Non-Key and ordering b. Non-Key and non-ordering c. Key and ordering d. Key and non-ordering
2.	An index is clustered, if [GATE 2013 : 1 Mark] a) It is on a set of fields that form a candidate key. b) It is on a set of fields that include the primary key. c) The data records of the file are organized in same order as the data entries of the index. d) The data records of the file are organized not in same order as the data entries of index.
3.	The order of an internal node in B+ tree index is the maximum number of children it can have. Suppose that a child pointer takes 6 bytes, the search field values takes 14 bytes, and the block size is 512 bytes. What is the order of the internal node? [GATE 2004 : 2 Marks] a.24 b.25 c.26 d.27
4.	The order of a leaf node in a B+ tree is the maximum number of (value, data-record pointer) pairs it can hold. Given that the block size is 1K bytes, data record pointer is 7 bytes long, the value field is 9 bytes long and a block pointer is 6 bytes long. What is the order of the leaf node? [GATE 2007: 2 Marks] a. 63 b.64

	c.67 d.68
5.	A B+ - tree index is to be built on the Name attribute of the relation STUDENT. Assume that all student names are of length 8 bytes, disk blocks are of size 512 bytes, and index pointers are of size 4 bytes. Given this scenario, what would be the best choice of the degree (i.e. the number of pointers per node) of the B+ - tree? [GATE 2002: 2 Marks] a) 16 b) 42 c) 43 d) 44
6.	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? [GATE 2010 : 1 Mark] a) 1 b) 2 c) 3 d) 4
7.	In a database file structure, the search key field is 9 bytes long, the block size is 512 bytes, a record pointer is 7 bytes and a block pointer is 6 bytes. The largest possible order of a non-leaf node in a B+ tree implementing this file structure is [GATE 2006 IT : 2 Marks] a) 23 b) 24 c) 34 d) 44
8.	Consider a table "T" in a relational database with a key field "K". A B-tree of order "p" is used as an access structure on "K", where "p" denotes the maximum number of tree pointers in a B-tree index node. Assume that "K" is 10 bytes long; disk block size is 512 bytes; each data pointer PD is 8 bytes long and each block pointer PB is 5 bytes long. In order for each B-tree node to fit in a single disk block, the maximum size of "p" is: [GATE 2004 IT : 2 Marks] a) 20 b) 22 c) 23 d) 32
9.	A B-tree used as an index for a large database table has four levels including the root node. If a new key is inserted in this index, then the maximum number of nodes that could be newly created in this process are a) 5 b) 4 c) 3 d) 2 [GATE 2005 IT : 2 Marks]
10.	A B-tree of order 4 is built from scratch by 10 successive insertions. What is the maximum number of node splitting operations that may take place? [GATE 2008 : 2 Marks] a) 3

	b) 4 c) 5 d) 6
11.	Consider a file of 16384 records. Each record is 32 bytes long and its key field is of size 6 bytes. The file is ordered on a non-key field, and the file organization is unspanned. The file is stored in a file system with block size 1024 bytes, and the size of a block pointer is 10 bytes. If the secondary index is built on the key field of the file, and multi-level index scheme is used to store the secondary index, the number of first-level and second-level blocks in the multi-level index are respectively? [GATE 2008 : 2 Marks] a. 8 and 0 b. 128 and 6 c. 256 and 4 d. 512 and 5
12	The following key values are inserted into a B+ tree in which order of the internal nodes is 3 and that of the leaf nodes is 2, in the sequence given below. The order of internal nodes is the maximum number of tree pointers in each node and the order of the leaf nodes is the maximum number of data items that can be stored in it. The B+ tree is initially empty. 10, 3, 6, 8, 4, 2, 1. The maximum number of times leaf nodes would get split up as a result of these insertions are ? [GATE 2009 : 2 Marks] a.2 b.3 c.4 d.5
13	Which of the following is correct? [GATE 1999: 1 Mark] a) B-trees are for storing data on disk and B+ trees are for main memory. b) Range queries are faster on B+ trees. c) B-trees are for primary indexes and B+ trees are for secondary indexes. d) The height of B+ tree is independent of the number of records.
TRANSCATION MANAGEMENT	
1.	Consider the following schedules involving the transactions. Which one of the following statements is TRUE ? [GATE 2007 : 2 Marks] S1 : r1(X); r1(Y); r2(X); r2(Y); w2(Y); w1(X) S2: r1(X); r2(X); r2(Y); w2(Y); r1(Y); w1(X) a. Both S1 and S2 are conflict serializable b. S1 is conflict serializable and S2 is not conflict serializable c. S1 is not conflict serializable and S2 is conflict serializable d. Both S1 and S2 are not conflict serializable
2.	Consider 2 transactions T1 and T2, and 4 schedules S1, S2, S3, S4 of T1 and T2 as given below:- T1: R1[x] W1[x] W1[y] [GATE 2009 : 2 Marks] T2: R2[x] R2[y] W2[y] S1: R1[x] R2[x] R2[y] W1[x] W1[y] W2[y] S2: R1[x] R2[x] R2[y] W1[x] W2[y] W1[y]

	S3: R1[x] W1[x] R2[x] W1[y] R2[y] W2[y] S4: R2[x] R2[y] R1[x] W1[x] W1[y] W2[y] Which of the above schedules are conflict serializable? a.S1 and S2 b.S2 and S3 c.S3 only d.S4 only
3.	Consider the following four schedules due to three transactions (indicated by the subscript) using read and write on a data tiem "x", denoted by r(x) and w(x) respectively. Which one of them is conflict serializable? [GATE 2014 Set:1 →2 Marks] a) r1(x); r2(x); w1(x); r3(x); w2(x) b) r2(x); r1(x); w2(x); r3(x); w1(x) c) r3(x); r2(x); r1(x); w2(x); w1(x) d) r2(x); w2(x); r3(x); r1(x); w1(x)
4.	Consider the transactions T1, T2, and T3 and Schedules S1 and S2 [GATE 2014 Set:3 → 2 Marks] a) Only S1 is conflict-serializable b) Only S2 is conflict-serializable c) Both S1 and S2 are conflict-serializable d) Neither S1 nor S2 is conflict-serializable
5.	Consider the following three schedules of transaction T1, T2 and T3. [GATE 2008 IT : 2 Marks] [Notation: In the following NYO represents the action Y (R for read, W for write) performed by transaction N on object O.] (S1) 2RA 2WA 3RC 2WB 3WA 3WC 1RA 1RB 1WA 1WB (S2) 3RC 2RA 2WA 2WB 3WA 1RA 1RB 1WA 1WB 3WC (S3) 2RA 3RC 3WA 2WA 3WB 3WC 1RA 1RB 1WA 1WB Which of the following statements is TRUE? a) S1, S2 and S3 are all conflict equivalent to each other b) No two of S1, S2 and S3 are conflict equivalent to each other c) S2 is conflict equivalent to S3, but not to S1 d) S1 is conflict equivalent to S2, but not to S3
6.	6. Consider the following schedule "S" of transactions T1, T2, T3, T4:- [GATE 2014 Set:2 → 2 Marks]

T1	T2	T3	T4
	Reads(X)		
		Writes(X)	
		Commit	
Writes(X)			
Commit			
	Writes(Y)		
	Reads(Z)		
	Commit		
			Reads(X)
			Reads(Y)
			Commit

a) S is conflict-serializable but not recoverable
b) S is not conflict-serializable but is recoverable
c) S is both conflict-serializable and recoverable
d) S is neither conflict-serializable nor recoverable

7. Consider the following schedule for transactions T1, T2, and T3:-
[GATE 2010 : 2 Marks]

T1	T2	T3
Read(X)		
	Read(Y)	
		Read(Y)
	Write(Y)	
Write(X)		
		Write(X)
	Read(X)	
	Write(X)	

Which one of the following schedules below is the correct serialization of the above?
a) T1 → T3 → T2 b) T2 → T1 → T3
c) T2 → T3 → T1 d) T3 → T1 → T2

8. Consider the following transactions with data items P and Q initialized to zero:
[GATE 2012 : 2 Marks]

T1	T2
read (P) ; read (Q) ; if P = 0 then Q : = Q + 1 ; write (Q) ;	read (Q) ; read (P) ; if Q = 0 then P : = P + 1 ; write (P) ;

Any non-serial interleaving of T1 and T2 for concurrent execution leads to
a) A serializable schedule
b) A schedule that is not conflict serializable
c) A conflict serializable schedule
d) A schedule for which a precedence graph cannot be drawn

9. Consider three data items D1, D2 and D3 and the following execution schedule of transactions T1, T2 and T3. In the diagram, R(D) and W(D) denote the actions reading and writing the data item D respectively.

[GATE 2003 : 2 Marks]

T1	T2	T3
	R(D3);	
	R(D2);	
	W(D2);	
		R(D2);
		R(D3);
R(D1);		
W(D1);		
		W(D2);
		W(D3);
	R(D1);	
R(D2);		
W(D2);		
	W(D1);	

a) The schedule is serializable as T2;T3;T1
b) The schedule is serializable as T2;T1;T3
c) The schedule is serializable as T3; T2; T1
d) The schedule is not serializable