KIIT Deemed to be University
Online End Semester Examination(Spring Semester-2021)

Subject Name & Code: Database Management Systems (CS 2004)

Applicable to Courses: B.Tech (CSE, IT, CSSE & CSCE)

Full Marks=50 **Time:2 Hours**

SECTION-A(Answer All Questions. Each question carries 2 Marks)

Time:30 Minutes **(7×2=14 Marks)**

Question No	Question Type (MCQ/SAT)	Question	CO Mapping	Answer Key (For MCQ Questions only)
Q.No:1	MCQ	Let R(m, n) and S(o,p) be two relations, then the outcome of the following SQL query *select distinct m,n* *from R, S* will be identical to R, if: (a) *S has no duplicates and R is non-empty* *(b) R has no duplicates & S is non-empty* *(c) R and S have no duplicates* *(d) R & S have the identical tuples*	CO2	B
	MCQ	Which of the following statement is equivalent to the 'SELECT' statement of SQL? a) selection operation in relational algebra b) projection operation in relational algebra c) selection operation in relational algebra, except that SELECT in SQL retains duplicates d) projection operation in relational algebra, except that SELECT in SQL retains duplicates	CO2	D
		Let R (A, B, C) be a relation as follows:		

	MCQ	<table><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>10</td><td>20</td><td>30</td></tr><tr><td>70</td><td>20</td><td>80</td></tr><tr><td>10</td><td>20</td><td>50</td></tr></table> What is the correct output of the following SQL query? SELECT COUNT(*) FROM (SELECT r1.A, r1.B, r1.C FROM R r1, R r2 WHERE r1.A = r2.A AND r1.B = r2.B); (a) 8 (b) 7 (c) 6 (d) 5	CO2	D
	MCQ	Which of the following statement is true regarding TRUNCATE, DELETE and DROP commands? I. DELETE is a DML statement, but TRUNCATE and DROP are DDL statements. II. DELETE operation can be rolled back but TRUNCATE and DROP operations cannot be rolled back. III. TRUNCATE and DROP operations can be rolled back but DELETE operations cannot be rolled back. IV. All are an example of DDL. a) I and III b) II and III c) II and IV d) I and II	CO2	D
Q.No:2	MCQ	In an Entity-Relationship (ER) model, let S is a many-to-one relationship from entity set R1 to entity set R2. Assume that R1 and R2 participate totally in S and that the cardinality of R1 is more than the cardinality of R2. Which one among the following is true about S? (a) Every entity in R1 is related to at least one entity in R2. (b) Every entity in R1 is related to exactly one entity in R2. (c) Every entity in R2 is related to maximum one entity in R1. (d) Every entity in R2 is related to exactly one entity in R1.	CO3	B
		Let us consider an ER diagram with following assumptions:		

	MCQ	(i) Let P, Q and S be three different entities in that ER diagram comprising single-valued attributes, except for S, which has only one multi-valued attribute. (ii) Let R1 and R2 be two relationships between P and Q, where R1 is one-to-many while R2 is many-to-many. (iii) Let R3 and R4 be two relationships between Q and S, where R3 is many-to-one while R4 is a many-to-many. (iv) Relationships R1, R2, R3 and R4 do not have any attributes of their own. How many minimum number of tables required to map this scenario into relational model? (a) 6 (b) 3 (c) 5 (d) 7	CO3	A
	MCQ	Consider the relations schema of the following STUDENT table: STUDENT(Roll_No, S_Name, Mail_id, Bank_Account_No,Hostel_Room_No) The attributes are described as follow: *Roll_No:* Roll number of each registered student, which is unique. *Mail_id :* Each students must have a unique mail-id. *Bank_Account_No:* Unique account number at the bank. A student can have multiple accounts or even joint accounts. This attribute stores the primary account number. *S_name:* Full name of the student. *Hostel_ Room_No:* Room number allocated to the student. Which of the following options is not correct? a) Mail_id is a candidate key. b) Roll_No can be a primary key. c) Bank_Account_No is a candidate key. d) If S is a super key such that 'S' ∩ '*Hostel_ Room_No'* is NULL then 'S' U '*Hostel_ Room_No'* is also a super key.	CO4	C
		1. Let us consider two relations P (u,v,w)		

	MCQ	and Q (a,b,c) where u denotes the foreign key of P which refers to the primary key of Q. Assume the following four tasks. (a)Insert into Q (b)Insert into P (c)Delete from Q (d)Delete from P Considering the above tasks, which of the following is correct regarding the referential integrity constraint: a) Operations (a) and (b) will cause violation. b) Operations (b) and (c) will cause violation. c) Operations (c) and (d) will cause violation. d) Operations (d) and (a) will cause violation.	C04	B
Q.No:3	MCQ	Once a transaction successfully completes its execution, all changes made by it in database persist, even if there are system failures. This feature is ensured by durability property of transaction. Which component of database system is responsible for implementing this durability: (a) Both Concurrency control component and Transaction management component. (b) Only Recovery management component. (c) Only Transaction management component. (d) Both Transaction management component and Recovery management component.	CO6	B
	MCQ	In lock based protocols. a transaction that holds a lock on a data item is allowed to change the lock from one mode to another under certain condition. Changing the mode of a lock that is already held is called lock conversion. Which among the following is true for lock conversion: I. In Lock Upgrading a shared lock is upgraded to an exclusive lock whereas an exclusive lock is downgraded to a shared lock in Lock Downgrading. II. Lock upgrading can take place only in the growing phase, whereas lock downgrading can take place both in growing	CO6	C

		as well as in the shrinking phase. III. Two-phase locking with lock conversion generates only conflict-serializable schedules. (a) Only I and II. (b) Only II and III. (c) Only I and III. (d) I, II and III		
	MCQ	The Timestamp Ordering Protocol is used to order the transactions based on their Timestamps. Here every transaction has a timestamp associated with it, and the ordering is determined by the age of the transaction. Let the transaction T1 entered the system at 004 times and another transaction T2 entered the system at 006 times. Then, which among the following is incorrect about Timestamp Ordering Protocol. I. The transaction T1 issuing a Read (X) operation will be rejected if TS(T1) < W_TS (X). II. This protocol is free from deadlock thus no transaction ever waits. III. The transaction T1 issuing Write(X) operation will be executed if TS(T1) < R_TS(X). a) Only I b) Only II c) Only III d) Both I and III	CO6	C
	MCQ	The atomicity property of a transaction despite failure can be ensured using two log based approaches which include deferred database modification and immediate database modification. If a transaction does not update the database until it has committed then which approach is recommended: (a) Deferred database modification (b) Immediate database modification (c) Both (d) Either of them	CO6	A
Q.No:4		Let R = (STUVWXYZ) be a relation schema with given set of functional dependencies, F = {UZ → Y, S → TU, T → UXZ, W → S, X → WY}.The feasible		

	MCQ	candidate keys of this relation are: a) SV, WV, TV, WY b) SV, UV, WV, XV c) SV, WV, TV, XV d) UV, XV, YV, WV	CO5	C
	MCQ	Normalization is a process of organizing the data in database to avoid data redundancy and anomalies. Several normal forms are used for this purpose. With respect to normal forms in database systems, which of the following is true: (a) Every relation in 3NF 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) 4NF is concerned with only join dependency.	CO5	C
	MCQ	Consider two relational schemes for a database: R1 (ABCDEF) and R2 (ABC) with the following functional dependencies: AB → C C → ABDE DE → F Assume {AB} is the key for both relations. Which of the following statements is true? (a) Both R1 and R2 are in BCNF (b) R1 is in 2NF and R2 is in 3NF (c) Both R1 and R2 are in 3NF only (d) Both R1 and R2 are in 2NF only	CO5	B
	MCQ	The maximum number of super keys possible for a relation schema R(PQRS) with P as the key is: (a) 6 (b) 7 (c) 8 (d) 9	CO4	C
Q.No:5		The three schema architecture in DBMS is used to describe the structure of a specific database system and is used to separate the user applications from the physical database. Which level in this architecture is used to define the low-level data structures: I. External level	CO1	B

	MCQ	II. Internal level III. Conceptual level (a) Only I (b) Only II (c) Both I and II (d) Both II and III		
	MCQ	Which of the following is not a super key in a relational schema with attributes {KLMNO} and primary key {KN}: (a) KLNO (b) KMNOL (c) KLOM (d) KLN	CO2	C
	MCQ	Statement 1: When a node is split during insertion in B+ tree, the middle key is promoted to the parent as well as retained in right half-node. Statement 2: A B+ tree can support both random access as well as sequential access. Statement 3: In a B+ tree, both the internal nodes and the leaves have keys. (a) Statement 1 and 3 are true. (b) Statement 2 and 3 are true. (c) Statements 1 and 2 are true. (d) All statements are true	CO6	C
	MCQ	A B+ tree is a balanced binary search tree which follows a multi-level index format where all leaf nodes remain at the same height. Consider a B+ tree comprising maximum of 9 pointers in a node. What is the minimum number of keys in leaves: (a) 3 (b) 4 (c) 5 (d) 6	CO6	B
Q.No:6	MCQ	I. A secondary index provides a secondary means of accessing a file for which some primary access already exists. II. The secondary index may be on a field which is a candidate key and has a unique value in every record, or a non-key with duplicate values.	CO6	A

		III. The secondary index is only based on a non-key with duplicate values. a) Statement I and II are true. b) Statement II and III are true. c) Statements I and III are true. d) All statements are true		
	MCQ	Let R(W,X,Y,Z) and X → Y && Z → W && WY→ Z, then using composition and/or pseudo-transitivity we can say: (a) Option 1: WX → Z (b) Option 2: XZ → YW (c) Both option 1 and option 2 (d) None of the above	CO5	C
		Let R(W,X,Y,Z). If X → Y && Z → W, then XZ → YW can be proved in a best way by using: (a) Reflexivity & Pseudo-transitivity (b) Augmentation & Union (c) Augmentation & Transitivity (d) Transitivity & Union	CO5	C
	MCQ	Which one of the following statements about normal forms is FALSE, when a relation schema, R, is decomposed into two sub-schemas R1 and R2? a) In lossless join decomposition, the common attribute must be a key for at least one relation. b) Lossless join and dependency preserving decomposition into 3 NF is always possible. c) Loss less join and dependency preserving decomposition into BCNF is always not possible d) None of the above	CO5	D
Q.No:7	MCQ	Let R(A, B, C, D, E, F) be a relation schema with sets of functional dependencies, F = P{AB → CDEF, C→D, E→F}. The domain of all attributes are atomic. In which highest normal form the relation schema R is?? a) 1NF b) 2NF c) 3NF d) None of the above	CO5	B
		A relation R(ABC) is having the following 4 tuples: (1,2,3), (4,2,3,), (5,3,3,) and (2,4,4,). Which of the following dependencies can		

	MCQ	you infer does not hold over relation R? a) C→B b) A→B c) AB→C d) B→C	CO5	A
	MCQ	An expression in the domain relational calculus is of the form a) a) {P(x1, x2, . . . , xn) | < x1, x2, . . . , xn > } b) {x1, x2, . . . , xn | < x1, x2, . . . , xn > } c) { x1, x2, . . . , xn | x1, x2, . . . , xn} d) {< x1, x2, . . . , xn > | P(x1, x2, . . . , xn)}	CO2	D
	MCQ	Which of the following concurrency control protocols ensure both conflict serialzability and freedom from deadlock? I. Time-stamp ordering protocol II. Two-phase locking protocol (a) II only (b) Both I and II (c) I only (d) None	CO6	A

SECTION-B(Answer Any Three Questions. Each Question carries 12 Marks)

Time: 1 Hour and 30 Minutes **(3×12=36 Marks)**

Question No	Question	CO Mapping (Each question should be from the same CO(s))
Q.No:8	A Company is organized into a number of departments. Each department has a unique name and location. An employee can manage only one department at a time and a department can be managed by only one employee. The Start date for the manager is recorded. Department may have several locations. A department controls a number of projects. Projects have a unique name, number and a single location. Company's employee's name, employee number (which is unique), address, salary, sex and birth date are stored. An	

	employee is assigned to only one department, but may work for several projects. Number of hours/week an employee works on each project is recorded. An employee may have dependant(s). Employee's dependants are tracked for health insurance purposes. The dependants record consists of dependent's name (not unique), birthdate, relationship to employee. All employee can be classified as officer or secretary, but not the both. (Note: All relations mentioned above are with employees but not explicitly with officer or secretary) (a) Construct an ER Diagram for the above problem description. Clearly mention all assumptions made by you in imposing constraints. **(8 marks)** (b) Map the ER diagram into relations and specify the primary keys and foreign keys of each relation. **(4 marks)**	CO3
Q. No. 8	Numerous educational institutions are present for which their unique inst_ID need to be stored along with inst_Name and domain. Every year a cultural event (unique eventID, eventName, eventTheme, budget) is conducted by every institution where huge gathering takes place. Each person in the gathering has unique personID WITH personName, age and address. People in the gathering can be classified as either employee (with salary) or student (with CGPA) or staffs (with working_hrs). All students in the events are managed by both employees and staffs. Every cultural event has various sessions (recognized by unique sessionID along with sessionName and sessionType). Students have the liberty to take part in one or multiple sessions. Likewise, many students can participate in one session. Different students are assigned as session coordinators for different session. Every session is associated with many awards and awardName with prize_money is linked to each award. Every award is identified by awardName for its own session. (a) Draw the ER model for the above scenario and highlight all essential assumptions . **(8 marks)** (b) Map the ER diagram into relations and specify the primary keys and foreign keys of each relation. **(4 marks)**	CO3
Q. No. 8	The Flight database stores detail about an airline's fleet, flights and seat bookings as per the following: The airline has one or more airplanes. An airplane is associated with a model number, a unique registration number and the capacity to take one or more passengers. An airplane flight has a unique flight number, a departure airport, a destination airport, a departure date and time and an arrival date and time. Each flight is carried out by a single airplane. A	CO3

	passenger has given names, a surname and a unique email address. A passenger can book a seat on a flight. It is to be noted here that, a pilot (who is an employee) can fly various airplanes, but allotted to only one flight. (a) Draw the ER diagram of the above problem description. Make necessary assumptions. **(8 marks)** (b) Map the ER diagram into relations and specify the primary keys and foreign keys of each relation. **(4 marks)**	
Q.No:9	What is an extraneous attribute? Given a relational Schema R(W, X, Y, Z) and set of Functional Dependencies, FD = { W → X, Y → X, Z → WXY, WY → Z }. Find the canonical cover? Mention all steps for finding the canonical cover. **(6 marks)** BCNF is a stronger form of normalization than 3NF. Justify. **(2 marks)** Find the highest normal form of given relation schema R(A,B,C,D,E) with set of functional dependencies, F = {AB→CE, BC→D, C→E}. **(4 marks)**	CO5
Q.No:9	1) Let R = (A,B,C,D,E) be a given relation schema with functional dependencies, F = {CE → D,D → B,C → A}. **(1+ 2+ 3 = 6 marks)** a) Find all candidate keys. b) Check whether R is in BCNF or not? c) If R is not in BCNF, then do the BCNF decomposition and check whether the decomposition is lossless and dependency preserving decomposition or not?? 2) Let R(UVWXY) be a relation schema with a set of functional dependencies, F={UV → WX, U → V, VY → XU, Y → X, W → X}. Compute a canonical cover of F. Show the intermediate steps of your derivation **(6 marks)**	CO5
Q.No:9	1) Let R = (A,B,C,D) be a given relation schema with functional dependencies, F = {AB → C, C → B, C → D}. **(2+4 = 6 marks)** a) Find candidate keys, prime attributes and non prime attributes of R. b) Is R in 3 NF or in BCNF? Justify. If not then normalize R. 2) Let R = (A,B,C) be a given relation schema with functional dependencies, F = {A→ BC, B → C, A → B, AB→C}. **(3+3 =6 marks)** a) Find the canonical cover of F. Show the intermediate steps of your derivation. b) Justify that the canonical cover of F is equivalent to F.	CO5

<table>
<tr><td>Q.No:10</td><td>1) Concurrency control helps in managing simultaneous operations without conflicting with each another. In relation to this, discuss with example the following problems that may be encountered during concurrency execution of transactions:
I. Lost update problem
II. Dirty read problem.
(6 marks)</td><td rowspan="2">CO6</td></tr>
<tr><td>2) Check whether the given schedules are conflict serializable or not using precedence graph.
a) R4(X), R2(X), R3(X), W1(Y), W2(X), R3(Y), W2(Y)
b) R1(X), R2(Z), R1(Z), R3(X), R3(Y), W1(X), W3(Y), R2(Y), W2(Z), W2(Y)
(6 marks)</td></tr>
<tr><td>Q.No:10</td><td>1. (6 marks)
Explain how serializability help to maintain the consistency of the database. Verify whether the given schedule S is conflict serializable or not, using precedence graph.
S : R1(A) , R2(A) , R1(B) , R2(B) , R3(B) , W1(A) , W2(B)

2. (4+2=6 marks)
a) Using label precedence graph, check whether the given schedule S with transactions T1, T2, and T3 is view serializable or not.

S= R1(A), R2(A), W3(A), W1(A)

b) Give your comment on the state of the following schedule with justification.

<table><tr><td>T1</td><td>T2</td></tr><tr><td>Lock-X(A)</td><td></td></tr><tr><td>R(A)</td><td></td></tr><tr><td>W(A)</td><td></td></tr><tr><td></td><td>Lock-X(B)</td></tr><tr><td></td><td>R(B)</td></tr><tr><td></td><td>W(B)</td></tr><tr><td></td><td>Lock-X(A)</td></tr><tr><td>Lock-X(B)</td><td></td></tr></table></td><td>CO6</td></tr>
<tr><td>Q.No:10</td><td>1. Check the serilaizability of the following schedules using precedence graph/ label precedence graph as per the question. (6 marks)
a) R2(X), W3(X), W1(X), W2(Y), R4(X), R4(Y), for conflict serializability.
b) R1(X); W1(X); R3(X); R2(X); W3(X), for view serializability.</td><td>CO6</td></tr>
</table>

	2. Consider the following log sequence of two transactions on a bank account, 'B', with initial balance 12000, that transfer 2000 to a mortgage, 'M', payment and then apply 5% interest. **(6 marks)** 1. <T1, START> 2. <T1, B, old = 12000, 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> Find the actions to be taken when the database system crashes just before log record 6, and just before log record 7 with the following updates: a) deferred update b) immediate update	
Q.No:11	1. Consider the relational scheme: **(8 marks)** EMPLYOEE (person_name, street, city) WORKS(person_name, company_name, salary) COMPANY(company_name, city) MANAGERS(person_name, manager_name) Give the expression in relational algebra of the following queries: a) Find the name of all employees who works for 'TCS' company. b) Find the name of all employees who earns more than every employee of 'Infosys' company. (without using aggregate function) c) Find the name of all employees who live in the same city and same street as do their managers. d) Give all employees a 10% salary rise. 2. Supported with suitable example (of your own) and schematic diagram, explain the primary index and secondary index. **(4 marks)**	CO4 & CO6
Q.No:11	1. Suppose we have an ordered data file with r = 24,000 records stored on a disk with block size B = 512 bytes. File record are of fixed size with record length, R = 120 bytes. One primary index file of the given data file is created based on ordering key field of the file. Assume that, the length of each index entry is 12 bytes (key field size= 7 bytes and a block pointer size = 5 bytes). Calculate the following: (8 marks) a) Blocking factor of data file and index file. b) Total number of blocks required for data file and index file. c) Number of block access on data file for a binary search. d) Number of block access on Index file for a	CO4 & CO6

	binary search. 2. Construct a B+ tree of order 3, for (1, 4, 7, 10, 16, 20, 32, 41). Mention all steps for every insertion during the creation of the tree. (4 marks)	
Q.No:11	1) Consider the airline flight relational schema details: Flight (flight-no, from, to) Aircraft (aid, aname, cruise_range) Certified (e-id, a-id) Employee (eid, ename, salary) Here the employee relation describes pilots and other kinds of employees as well. Every pilot is certified for some aircraft (else he/she will not qualify as a pilot) and only pilots are certified to fly. With respect to this, write the following queries in relational algebra. (8 marks) I. Find the eid of pilots certified for boeing aircraft. II. Find the names of pilots certified. III. Find the aid of all aircraft that can be utlized on non-stop flights from Bhubaneswar to Delhi. IV. Determine the flights that can be piloted by every pilot whose salary is greater than Rs. 100,000.	CO4 & CO6
	2.) Construct a B+ tree of order 4, for letters (M, O, T, H, E, R, L, A, N, D) Mention all steps for every insertion during the creation of the tree. (4 marks)	

CO #	Detail
CO1	Describe the fundamentals of relational database management systems
CO2	Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
CO3	Design ER-models to represent simple database application scenarios
CO4	Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
CO5	Improve the database design by normalization.
CO6	Familiar with transaction processing, basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing..