F – 55021

Register No.

BTech Degree Examination December 2022

Fourth Semester

Information Technology

20ITT42 – DATABASE MANAGEMENT SYSTEMS

(Regulations 2020)

Time: Three hours

Maximum: 100 marks

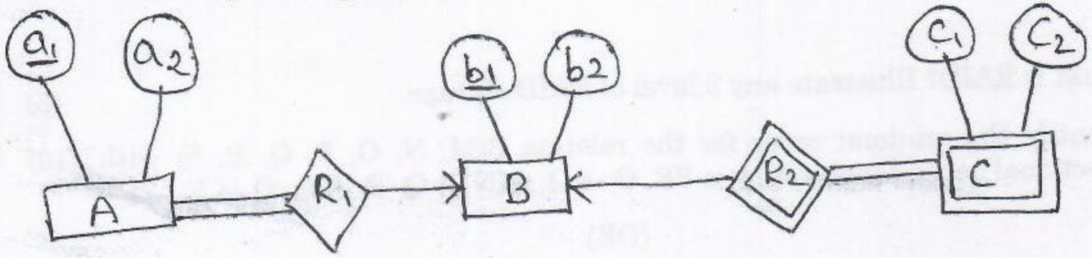
Answer all Questions

Part – A (10 × 2 = 20 marks)

1. Illustrate all possible super keys for the Relation Employee (Eid, E_Name, Age) where Eid is the only key of the Relation. [CO1,K3]

2. List the different views of data. [CO1,K1]

3. Consider the following ER diagram. [CO2,K3]



Calculate the minimum number of tables needed to represent A, B, C, R1 and R2.

4. Compare Inner Join and Outer Join. [CO2,K2]

5. Let R(A, B, C, D, E, F) be a relation with following functional dependencies C → F, E → A, EC → D, A → B. Identify the candidate keys of the Relation R. [CO3,K3]

6. Define Fixed Length Record. [CO3,K1]

7. Differentiate dense index and sparse index. [CO4,K2]

8. What is the use of ACID property in transactions? [CO4,K1]

9. How the Read Time-Stamp (RTS) and write Time-Stamp (WTS) values of a data are assigned. [CO5,K2]

10. What is stable storage? [CO5,K1]

Part – B (5 × 16 = 80 marks)

11. a. Draw Database system architecture and explain each components in detail. (16) [CO1,K2]

(OR)

b. List the basic operators in Relational Algebra and explain each operator with example. (16) [CO1,K2]

b. i) Test the following schedule S for conflict serializability. If the schedule is conflict serializable then show the possible order of execution of Transactions. (8) [CO4,K3]

Schedule S: $R_2(B)$, $R_1(C)$, $W_4(B)$, $R_3(A)$, $W_1(A)$,$R_3(B)$,$W_2(A)$, $W_4(D)$

ii) Consider the following non-serial schedule S $R_1(A)$, $W_2(B)$, $R_2(C)$, $R_3(A)$, $W_1(B)$, R1(D) Test the above schedule for view serializability. (8) [CO4,K3]

15. a. i) What is Deadlock? Explain in detail about deadlock prevention strategies. (8) [CO4,K3]

ii) Schedule S: $R_2(A)$. $W_2(B)$, $R_3(A)$, $W_1(B)$,$R_1(D)$, $R_2(E)$, $R_4(D)$, $W_4(D)$ (8) [CO5,K3]

Show the execution of schedule S using Time-Stamp Ordering Protocol. Where initial value of R-TS and W-TS of data A, B, D, E is 0 and assume TS (T_1) = 1, TS (T_2) = 2, TS(T_3) = 3, TS (T_4) =4

Where R-TS:- Read Time-Stamp

W-TS:- Write Time-Stamp

(OR)

b. i) Explain in detail about Recovery Algorithm. (8) [CO5,K2]

ii) What is the advantage of using checkpointing in Recovery Algorithm? Prepare the undo and Redo list of Transactions for the following Log records where Immediate database modification technique is used. (8) [CO5,K3]

<T_1, start>

<T_1, A, 100, 50>

<T_2, start>

<T_1, B, 50, 100>

<T_1, COMMIT>

<T_3, start>

<T_4, start>

<T_2, M, 10, 15>

<T_3, N, 5, 10>

<checkpoint L>

<T_3, commit>

<T_4, O, 20, 10>

(System Crash)

Bloom's Taxonomy Level	Remembering (K1)	Understanding (K2)	Applying (K3)	Analysing (K4)	Evaluating (K5)	Creating (K6)
Percentage	8	36	56	-	-	-

12. a. Consider following Relations, [CO2,K3]

Customer (Cid, C_name, C_city)
Product (Pid, P_name, Quantity)
Order (Oid, Cid, Pid)

i) Write a SQL query to create customer and order table (4)

ii) Write a SQL query to alter product table by adding new column date and must required value constraint on P_name. (4)

iii) Write SQL query to assign find the count of customers who has bought 'cinthol-soap'. (4)

iv) Write a SQL query to find the city wise count of customers who has bought 'cinthol-soap'. (4)

(OR)

b. Draw ER-diagram for college management system with following Entities and conditions, (16) [CO2,K3]

Entity: Student, Department, Course, Course-Registered conditions.

- * Associate every student entity with atmost one Department entity
- * Associate every student entity with atleast two course-registered Entity
- * Associate every department entity with atleast one course Entity

Construct Table for the above ER-diagram.

13. a. i) What is RAID? Illustrate any 3 level of RAID storage. (6) [CO3,K2]

ii) Identify the minimal cover for the relation R(M, N, O, P, Q, R, S) with functional dependencies MN → PR, O → Q, MN → Q, R → S, Q → R (10) [CO3,K3]

(OR)

b. i) List the types of Anomalies with example. (6) [CO3,K2]

ii) Consider relation R(A, B, C, D, E, F, G) with functional dependencies A → C, B → DE, E → D AD → G. Normalize the relation till 3 NF. (10) [CO3,K3]

14. a. i) Construct B$^+$ Tree using the following sequence of search keys 12, 5, 2, 7, 21, 11, 14, 9, 18, 13, 6, 23 The order of the B$^+$ Tree is 4. (8) [CO4,K3]

ii) Construct Bitmap Index for the following student relation, and illustrate the execution of following SQL Query, (8) [CO4,K3]

Select * from student where Department = 'CSE' and Grade = 'A'

SID	Department	Grade
101	CSE	A
102	IT	B
103	CSE	B
104	CSE	A
105	MECH	A
106	CSE	C

(OR)

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE- 638 060
B.Tech Degree Examinations December 2022
Fourth Semester
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20ITT42 – Database Management Systems
Answer Key
(Regulation 2020)

Part A (10 x 2 = 20 Marks)

1. Possible super keys are {{Eid}, {Eid, E_Name}, {Eid, Age}, {Eid, E_Name, Age}

2. Different views of data are,
    - user level or view level
    - conceptual or logical
    - physical level

3. 3 tables are required and the tables are,
   A(a1, a2, b1)
   B(b1, b2)
   C(b1, c1, c2)

4.

Inner Join	Outer Join
• When any attributes are not common then it will return nothing. • If tuples are more. Then INNER JOIN works faster than OUTER JOIN.	• It does not depend upon the common attributes. If the attribute is blank then there is already placed NULL. • Generally, The OUTER JOIN is slower than INNER JOIN. But except for some special cases.

5. Candidate key of the relation R is EC.

6. Fixed length records are exactly the same length. Access to the records is easier and faster. Exact location of the records can be determined. If the record size exceeds the fixed size, it gets divided into more than one block.

7.

Dense Index	Sparse Index
• When any attributes are not common then it will return nothing. • If tuples are more. Then INNER JOIN works faster than OUTER JOIN.	• It does not depend upon the common attributes. If the attribute is blank then there is already placed NULL. • Generally, The OUTER JOIN is slower than INNER JOIN. But except for some special cases.

8. ACID property ensures that all changes to data are performed or none of them are performed. ACID properties are,
    - Atomicity
    - Consistency
    - Isolation
    - Durability

9. Read Time-Stamp (RTS) value of a data are assigned with the id of the transaction which reads that data.
   Write Time-Stamp (WTS) value of a data are assigned with the id of the transaction which

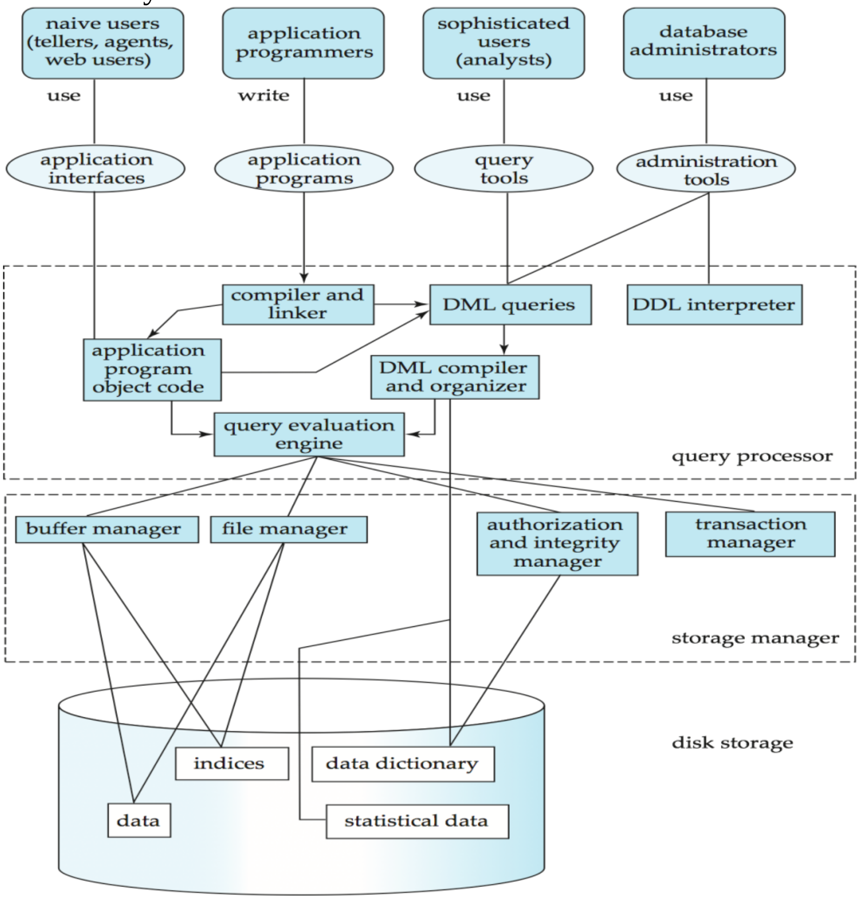
modifies that data.

10. Stable storage guarantees atomicity for any given write operation and allows software to be written that is robust against some hardware and power failures.

PART – B (5 x 16 = 80 Marks)

11. a) Database System Architecture.

(10)



Database Users:

Naïve users or End users – don’t have any DBMS knowledge but they frequently use the data base applications in their daily life.

Application Programmer - writes the code for the application programs. (6)

Sophisticated Users - They don’t write the program code but they interact the data base by writing SQL queries directly through the query processor.

Database Administrator - Defines the schema and also controls the 3 levels of database

Query Processor:

- The query processor components include:
  - DDL interpreter -- interprets DDL statements and records the definitions in the data dictionary.
  - DML compiler -- translates DML statements in a query language into an evaluation plan consisting of low-level instructions that the query evaluation engine understands.

Storage Manager:

- A program module that provides the interface between the low-level data stored in the database and the application programs and queries submitted to the system.

- The storage manager is responsible to the following tasks:
    - Interaction with the OS file manager
    - Efficient storing, retrieving and updating of data

Data dictionary:
Data dictionarycontains metadata (i.e., data about data)

- Database schema
- Integrity constraints
    - Primary key (ID uniquely identifies instructors)
- Authorization

11. b) Basic Operators in Relational Algebra. (8)

- **Select** Operation (or σ): The SELECT operation is used for selecting a subset of the tuples according to a given selection condition.
- **Project** Operation (or ∏): The projection eliminates all attributes of the input relation but those mentioned in the projection list
- **Union** Operation (or ∪): It includes all tuples that are in tablea1 or in 2. It also eliminates duplicate tuples
- **Set Difference** Operation (or −): The result of A – B, is a relation which includes all tuples that are in A but not in B
- **Cartesian Product** Operation (or X): The Cartesian product is used to combine each row in one table with each row in the other table. It is also known as a cross product.
- **Rename** Operation (or ρ): Rename is a unary operation used for renaming attributes of a relation

Example similar to the following are accepted:

Select: $\sigma_{\text{topic = "Database"}}$(Customers)

Project Operation: $\Pi_{\text{CustomerName, Status}}$(Customers) (8)
Union Operation: Table1 U Table2
Set Difference: Table1 – Table2
Cartesian Product: Table1 X Table2
Rename: $\rho\ (newTableName, OldTableName)$

12. a) i) create table Customer (Cid number(10) primary key, C_name varchar(50), C_city varchar(20); (2)

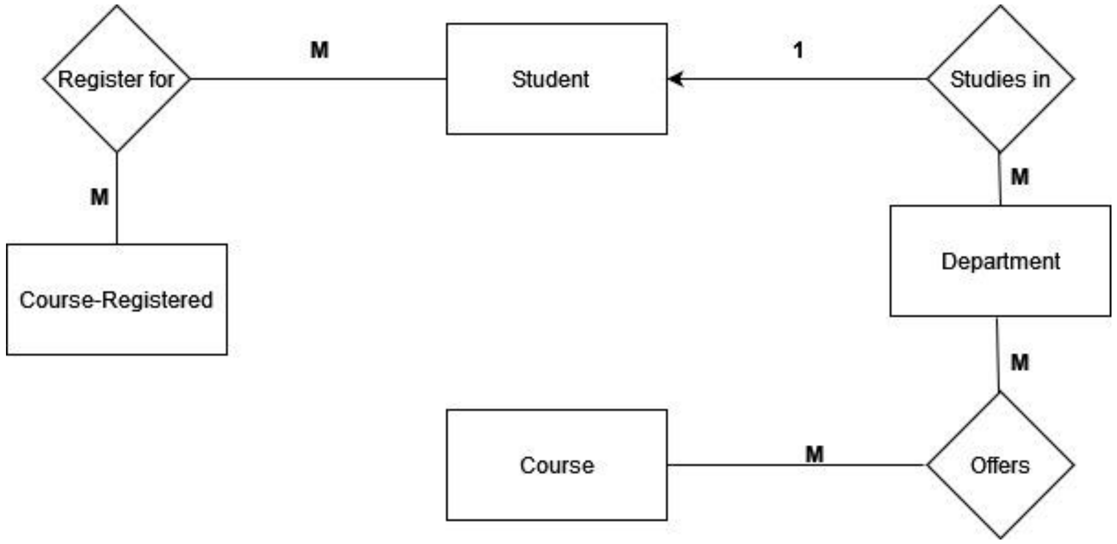
create table Order (Oidnumber(10), Cid number(10) references Customer(Cid), Pid number(10) references Product(Pid); (2)

ii) alter table Product add column date date; (2)
alter table Product modify column P_namevarchar(50) not null; (2)

iii) Select count(distinct(Cid)) from Order where Pid in (Select Pid from Product where P_name = “cinthol-soap’); (4)

iv) Select count(Cid) from Customer (Select Cid from Order where Pid in (Select Pid from Product where P_name = “cinthol-soap’)) group by C_city; (4)

12. b) ER-diagram similar to the following is accepted. (16)



Entities should have attributes

13. a)i) RAID (Redundant array of independent disks) is a technology to connect multiple secondary storage devices and use them as a single storage media. (2)

Any 3 following RAID levels

RAID Level 0: Block striping; non-redundant. (4)

RAID Level 1: Mirrored disks with block striping

RAID Level 2: Memory-Style Error-Correcting-Codes (ECC) with bit striping.

RAID Level 3: Bit-Interleaved Parity

RAID Level 4: Block-Interleaved Parity; uses block-level striping, and keeps a parity block on a separate disk for corresponding blocks from N other disks

RAID Level 5: Block-Interleaved Distributed Parity; partitions data and parity among all N + 1 disks.

RAID Level 6: P+Q Redundancy scheme

13. ii) **Split the right-hand attributes of all FDs.** (3)

MN -> P
MN -> R
O -> Q
MN -> Q
R -> S
Q -> R

Remove all redundant FDs. (3)

MN -> R is redundant remove it
MN -> P
O -> Q
MN -> Q
R -> S
Q -> R

Find the Extraneous attribute and remove it. (4)

There is no extraneous attribute. The minimal cover of R is
MN -> P
O -> Q
MN -> Q
R -> S
Q -> R

13. b)i) Anomalies:Problems encountered with bad schema design are anomalies. Types of anomalies, insert, delete and update. (3)
Insertion Anomaly:An Insert Anomaly occurs when attributes cannot be inserted into the database without the presence of other attributes. Usually when a child is inserted without parent.

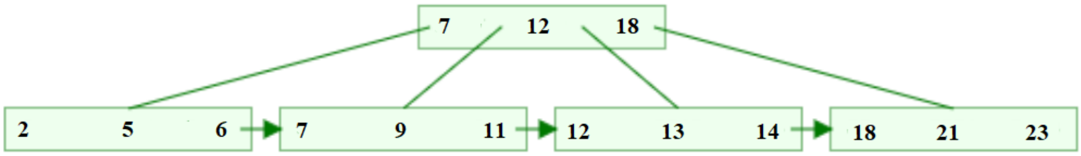
Update Anomaly:When duplicated data is updated at one instance and not across all instances where it was duplicated.

Deletion Anomaly:deletion of some attribute which causes deletion of other attributes is deletion anomaly.

Example relational table representing above anomalies. (3)

13. ii) Candidate keys ={ABF} (2)
Prime attribute = {A,B,F}
Non-prime attributes={C,D,E,G}
Given table is violating 2 NF. Decompose the relation till 3NF is achieved.
Relational tables after decomposition are,
R1(A,C) (6)
R2(B,D,E)
R3(D,E)
R4(A,D,G)
R5(A,B,F)

14 a) i) B^+ Tree: (8)



14 a) ii) Bitmap Index for attributes: (2)
Department CSE: 101101
Grade A: 100110

Select * from student where Department ='CSE' and Grade='A';
Use and operator on CSE & Grade A index to complete the given above query
Department CSE: 101101
Grade A: 100110
Result : 100100 (6)

The result shows that **rows 1 and 4 are the output** for the given query.

14. b) i) Test for conflict serializability: (2)

T1	T2	T3	T4
	R(A)		
	W(B)		
		R(A)	
W(B)			
R(D)			

	R(E)		
			R(D)
			W(D)

The given schedule is **conflict serializable.** (6)
The possible order of executions are:
T3 -> T2 -> T1-> T4
T2 -> T3 -> T1 -> T4
T2 -> T1 -> T4 -> T3

14. b) ii) Test for view serializability: (2)

T1	T2	T3
R(A)		
	W(B)	
	R(C)	
		R(A)
W(B)		
R(D)		

T1 and T2 are conflicting transactions so T2 should appear before T1 executes. (6)
The given schedule is **conflict serializable. All conflict serializable schedules are view serializable.**
Hence the given schedule is view serializable.

15. a) i) Deadlock:A deadlock is a condition where two or more transactions are waiting indefinitely for one another to give up locks (2)

wait-die scheme — non-preemptive (6)

- Older transaction may wait for younger one to release data item.
- Younger transactions never wait for older ones; they are rolled back instead.
- A transaction may die several times before acquiring a lock

wound-wait scheme — preemptive

- Older transaction wounds (forces rollback) of younger transaction instead of waiting for it.
- Younger transactions may wait for older ones.
- Fewer rollbacks than wait-die scheme.

15. a) ii) $TS(T_1) = 1$, $TS(T_2) = 2$ $TS(T_3) = 3$ and $TS(T_4) = 4$ (2)
R-TS(A) = W-TS(A) = 0
R-TS(B) = W-TS(B) = 0
R-TS(D) = W-TS(D) = 0
R-TS(E) = W-TS(E) = 0

(6)

Operation	A		B		D		E		Execute
	RTS(A)	WTS(A)	RTS(B)	WTS(B)	RTS(D)	WTS(D)	RTS(E)	WTS(E)	
initial value	0	0	0	0	0	0	0	0	T
R2(A)	2	0	0	0	0	0	0	0	T
W2(B)	2	0	0	2	0	0	0	0	T
R3(A)	3	0	0	2	0	0	0	0	T
W1(B)	3	0	0	2	0	0	0	0	F

R1(D)	3	0	0	2	1	0	0	0	T
R2(E)	3	0	0	2	1	0	2	0	T
R4(D)	3	0	0	2	4	0	2	0	T
W4(D)	3	0	0	2	4	4	2	0	T

W1(B) is not allowed as it tries to update the obsolete value.

15. b) i) Recovery Algorithm: (2)

- Database systems, like any other computer system, are subject to failures but the data stored in it must be available as and when required.
- Recovery techniques are heavily dependent upon the existence of a special file known as a system log.
- The log keeps track of all transaction operations that affect the values of database items.
- **Recovery from failure**: Two phases
    - **Redo phase**: replay updates of **all** transactions, whether they committed, aborted, or are incomplete (6)
    - **Undo phase**: undo all incomplete transactions.

ii) Advantage of Checkpointing: (2)

- Allows for faster recovery in the event of a system failure or crash.
- Reduce the time required for recovery in case of an instance or media failure.

(6)

Undo List = {T2, T4}

Redo List = {T3}