Ref. No.: Ex/IT/PC/B/T/213/2024

Bachelor Of Engineering In Information Technology

2nd Year 1st Semester, Semester Examination, 2023-2024

Subject Name –(IT/PC/B/T/213) Database Management Systems

Time: 3 Hrs. **Full Marks=100**

CO1 [10]

Q1.

(a) Discuss the three levels of abstraction in a database.

(b) Define data independence and explain its significance in a DBMS.

(c) Discuss the role of the Data Dictionary in a DBMS.

OR

Explain the role of DBA.

[4+4+2=10]

CO2 [20]

Q2.

(a) Explain the concept of transitive dependency in the normalization process. How does it relate to achieving higher normal forms?

(b) Consider the following instance of the relational schema:

Enrollment (RegistrationNo, CourseId, CourseName Fees)

RegistrationNo	CourseId	CourseName	Fees
101	11	IT	1000
102	11	IT	1000
101	12	CSE	2000
102	12	CSE	2000
103	13	EE	3000
104	14	ECE	4000

Justify that the following **functional dependencies** hold or not. (Mentions all steps)

i) RegistrationNo → CourseId

ii) CourseId → CourseName

(c) Identify all candidate keys for the instance of a relation **(Enrollment)** given above.

(d) Consider the relational schema: **R (a, b, c)**

With functional dependency:

F1: {a, b}→c

F2: c→b)

Identify all **candidate key(s)** for the above relation.

What is the **highest normal form** of R?

[5+6+3+6=20]

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CO3 [20]

Q3.

(a) Define the **Division** operation in relational algebra. Provide an example scenario where the Division operation is applicable.

(b) Consider the instances of two relations **Faculty** and **Department**:

Faculty	
ID	DepartmentName
1	CS
2	IT
3	IT
4	EE

Department	
DepartmentName	Students
CS	60
IT	70
EE	50

Find out the output of the relational algebra given below:

$$\Pi_{\texttt{Faculty.ID}}(\sigma_{\texttt{Department.DepartmentName="IT"}}(\texttt{Faculty} \times \texttt{Department}))$$

(c) Consider the following schemas given below:

sailor(sid,sname,rating,age)
boat(bid,bname,colour)
reserve(sid,bid)

Write down the relational algebra expression equivalent to the following statement given below.

i) Display the **names of sailors** along with the **count of boats** they have **reserved**.

ii) Display the names of sailors who are either **rated 8** or reserved a boat of a colour other than **'blue'**.

iii) List the **names of sailors** who have **not made** any reservations.

[6+5+9=20]

CO4 [20]

Q4.

(a) Explain the concept of a **database indexing** and how it improves **query performance**.

OR

Justify this statement given below:

"Size of non-leaf nodes of B+ tree is larger than the leaf nodes".

(b) A hash table contains 10 (indices 0 to 9) buckets and uses linear probing to resolve collisions. The key values are integers and the hash function used is (key % 10). Given the input keys **(521, 124, 135, 381, 164, 327, 373, 831)**. Apply the hash function to each key and determine the resulting hash values.

(c) Suppose a file is organized using a **B+ tree of order 4**. The search-keys are inserted in the following order: **1, 4, 7, 10, 17, 21, 31, 25, 19, 20, 28, 42.**

Draw the **B+ tree** and justify this statement **"The Key 21 will be in root node".**

[4+8+8=20]

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CO5 [20]

Q5.

(a) Consider the following schedule S involving **five transactions T_1, T_2, T_3, T_4, T_5.**

T_1	T_2	T_3	T_4	T_5
	R(X)			
		W(X)		
		R(Y)		
W(Y)				
R(X)				
			R(X)	
			W(X)	
				R(Y)

R(X) denotes read operation on data item X by transaction T_i.
W(X) denotes write operation on data item X by transaction T_i.
Identify whether the provided schedule S is a **conflict serializable schedule**, a **view serializable schedule, both, or none of these.** In the case of **conflict serializability**, determine the possible number of conflict serializable schedules, and for each identified schedule, provide **the correct order of execution.**

OR

Consider the following **two schedules S1 and S2** given below.

S1	
T_1	T_2
	R(X)
	W(X)
	COMMIT
R(X)	
W(X)	
COMMIT	

S2	
T_1	T_2
R(X)	
W(X)	
	R(X)
	W(X)
COMMIT	
	COMMIT

Justify these two statements:

(i) "Both schedules S1 and S2 are Cascadeless Schedule".

(ii) "The schedule S1 is Cascadeless Schedule but the schedule S2 is a Recoverable Schedule".

(b) Assume an **immediate database modification scheme**. Consider the following log records for transactions T1, T2, T3 and T4:

steps	Details of log
1	⟨T3,start⟩
2	⟨T3,A,200,400⟩
3	⟨T2,start⟩
4	⟨T2,B,300,600⟩
5	⟨T2,commit⟩
6	⟨checkpoint{T3} ⟩
7	⟨T1,start⟩
8	⟨T1,C,400,800⟩
9	⟨T4,start⟩
10	⟨T3,commit⟩
11	⟨T4,D,300,700⟩

If there is a **crash** just after step 11 and the recovery of the system is successfully completed, identify the **final values of all data items, undo list, redo list and no action list** of transactions if any for the above scenario.

(c) Compare and contrast Rigorous 2PL with Strict 2PL in DBMS. **[8+8+4=20]**

CO6 [10]

Q6.

(a) Write down the advantages of Distributed databases over Centralized databases.

(b) Write down the 5V's (characteristics) of big data. **[5+5=10]**

(IT/PC/B/T/213) Database Management Systems:

After completing this course, the students should be able to:

CO1: Explain the basic Database concepts and different data models. (K2)

CO2: Find the available functional dependencies to apply normalization concepts in typical scenarios. (K3)

CO3: Design queries using relational algebra operations and SQL. (K3)

CO4: Explain principles of Physical Data Storage and Query Optimization. (K3)

CO5: Comprehend transaction processing and concurrency control techniques and apply them in various problems (K3)

CO6: Discuss different types of advanced databases. (K2)