


VIT

Vellore Institute of Technology

Final Assessment Test – November 2025

Course: **CSI1001** - Principles of Database Systems

Class NBR(s): 1634/1637/1640/2027

Slot: B1

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Acquire a good understanding of the architecture and functioning of database management systems
CO2	Ability to construct an ER model, derive the relational schemas from the model
CO3	Analyze and improve a database design by normalization.
CO4	Ability to associate the basic database storage structure and access techniques including B Tree and B+ Tress
CO5	Analyze the basics of query evaluation and heuristic query optimization techniques.
CO6	Learn concepts of concurrency control for the desirable database problem.
CO7	Analyze the fundamental concepts of recovery mechanisms and learn the recent trends in database.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions

(10 X 10 = 100 Marks)

1.
 - a) Compare and contrast the Hierarchical, Network, and Relational data models in terms of structure, data access, flexibility, and real-world applications. CO1 BL2
 - b) Illustrate the Three-Schema Architecture in DBMS with reference to a University database. Explain how each of the levels interact in this scenario.
2. Consider the following relational schema of a Database: CO1 BL2

Customer(CID, CName, CAddress)
 Product(PID, PName, PType)
 Order(CID, PID, Price)

Write the following queries in relational algebra:

 - a) Find the names of customers who ordered an electronics product that costs less than Rs.1000.
 - b) Find the names of customers who ordered an electronics product costing <1000 and a kitchen item costing <1000.
 - c) For every customer who ordered both electronics and kitchen items, display the customer's name and the highest price they paid for any product.
 - d) Find the names of customers who ordered every product in the product catalog.
 - e) Find the CIDs of customers who ordered only electronics.

3. A restaurant which has several branches, maintains the records about its Employees, Customers, Orders etc.

CO2 BL3

- The restaurant registered its name with the food safety authority and obtained a unique restaurant ID.
- This restaurant has several branches at several locations, depending on the food type such as {Veg, Non-Veg, Both}.
- Each branch has a unique Branch_ID, City_Name and Phone Number.
- Information such as Name, designation, ID of employees who work for one of these branches is recorded.
- Each of the branch is managed by one of the employees of the branch.
- The number of employees working in each branch can be calculated using the employee ID and the Branch ID.
- Each Branch of the restaurant offers food menu consisting of information such as food name, price, and ingredients.
- Customer when places an order of several items from the food menu, the price is aggregated, an order number is generated on customer name and also the time of order and delivery time and the order date is recorded.
- The customer information such as customer name, phone number, email are collected for delivery and feedback mechanism.

- (a) Identify the Entities and Attributes in this Schema.
- (b) Identify the Primary and Foreign keys in this Schema.
- (c) Identify the weak attributes, if any.
- (d) Identify the multi-valued and composite attributes, if any.
- (e) Represent diagrammatically, the following relationship and indicate the participation constraints and cardinality ratios.
 - o (managed) between the Employee and Branch.
 - o (working in) between the Employee and Branch.
 - o (Orders) between the Order and food menu .

4. (a) Discuss in detail, the types of Anomalies in the construction of a relational database.

CO3 BL3

- (b) Consider the following relation state in which the Library book information along with the borrower and the school information are given. Discuss the anomalies that may occur during insertion/ deletion/ updation of data in this relation.

Book_ID	RollNo	Name	School	School_Dean	Shelf
1	14	Allen	ECE	Hilbert	2
2	3	Bob	CSE	Robert	1
3	19	Carl	CSE	Robert	2
4	32	Dany	CSE	Robert	3
5	10	Elsa	EEE	Smith	1

5. Given a relational schema $R(A,B,C,D,E,F)$, with the set of functional dependencies $\{A \rightarrow C, B \rightarrow F, D \rightarrow E, AD \rightarrow BF\}$.

CO3 BL3

- (a) Find all the candidate keys of the relation R .
(b) With appropriate justification specify the normal form of the given relation ' R '.

Decompose the relation upto Boyce-Codd Normal form. In each stages mention the decomposed relations.

- 6.a) Given the following relations:

CO5 BL3

Flights(Fl_No , From, To, Dep_time, Arr_time), with attributes Flight Number, From, To, Departure and Arrival times,

Aircraft(AID , AName, Cruising_range), with attributes Aircraft ID, Aircraft Name, Maximum cruising range,

Employee(EID , EName, Salary) with attributes Employee ID, Employee name and salary, and Certified(EID , AID) with the keys EID and AID as attributes.

Here, Employee relation describes all employees which include pilots in it. An employee who is certified to fly at least one aircraft is called a pilot. Every aircraft has a particular cruising range and beyond its range, it is not allowed to fly.

It is required to find the flight numbers and the names of eligible pilots who have to fly beyond 4000 km and whose salary is between Rs.2,00,000 and Rs.4,00,000.

- Write the SQL query for the retrieval of the above information.
- Draw the initial query tree.
- Optimize the query using Heuristic approach and draw the final query tree.

OR

- 6.b
- What is the difference between Lost update problem and Temporary update problem in transaction processing? Discuss with an example each.
 - For the following schedule S , find all the conflict operations and check whether S is conflict serializable or not. If yes, find the serialized schedules.

CO5 BL3

$S: r_1(X); r_2(X); r_1(Y); w_2(X); r_2(Y); w_2(Y); r_4(X);$
 $r_3(Y); r_3(Z); r_4(Z); w_4(Z); r_4(Y); r_3(X); w_3(X)$

7. Explain the characteristics of the RAID levels 0, 1 and 10. Discuss the advantages and disadvantages of each level. **CO4 BL2**

8.a) Construct a B+-tree for the set of key values: {5, 15, 35, 24, 12, 30, 21, 17, 9, 27, 32, 13}. Assume the tree is initially empty the values are added in ascending order and 4 pointers to fit a node. **CO4 BL3**

OR

8.b) Suppose that we are using extendable hashing on a file that contains records with the search key values 5, 9, 13, 1, 17, 21, 23, 10, 24, 31. Show the extendable hash structure for this file, given the hash function returns n least significant bits, n being the global depth and buckets can hold 3 records. **CO4 BL3**

9. a) Describe how a typical lock manager is implemented. **CO6 BL4**

b) Explain why downgrades violate 2PL but are nonetheless acceptable.
Discuss the use of update locks in conjunction with lock downgrades.

c) Explain the role of timestamps assigned to restarted transactions with respect to deadlock prevention and the concurrency control.

10. Discuss the following techniques of recovery: **CO7 BL2**

- a) Deferred update technique.
- b) Immediate update technique.
- c) Shadow paging.

In each case, discuss the advantages and disadvantages.

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