VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of the UGC Act, 1956)

Reg. No. : 22BCE1559

Final Assessment Test (FAT) - May 2024

Programme	B.Tech.	Semester	WINTER SEMESTER 2023 - 24
Course Title	DATABASE SYSTEMS	Course Code	BCSE302L
Faculty Name	Prof. Premalatha M	Slot	A1+TA1
		Class Nbr	CH2023240502438
Time	3 Hours	Max. Marks	100

General Instructions:

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Answer all questions (10 X 10 Marks = 100 Marks)

01. ABC Car Manufacturing Company is implementing a three-tier architecture for its database management system. The architecture consists of a presentation tier, an application tier, and a data tier. [10]

    a) As a database administrator of the car manufacturing company, explain the responsibilities (3 marks)

    b) Describe the three-tier architecture for the given specification with a neat diagram. (7 marks)

02. You are hired to design an Extended Entity-Relationship (EER) diagram for a vehicle management system for a rental company. The system needs to support various types of vehicles, each with unique attributes. Design an EER diagram that incorporates superclasses, subclasses, overlapping, and disjoint attributes to accurately represent the types of vehicles and their characteristics in the system. Make your assumptions wherever necessary. [10]

    - Vehicle is identified by VehicleID, Make, Model, Year, Color, etc.
    - Car, a type of vehicle, identified by NumDoors, NumPassengers, TransmissionType, etc.
    - Truck, another type of vehicle identified by CargoCapacity, TruckType, FuelType, etc.
    - Motorcycle, a third type of vehicle identified by EngineSize, FuelCapacity, MotorcycleType, etc.
    - Some attributes may apply to more than one subclass. For example, "FuelType" could apply to both trucks and motorcycles.
    - Some attributes may be unique to a particular subclass. For example, "NumDoors" would only apply to cars, not to trucks or motorcycles.
    - Company is identified by the CompanyID, CompanyName, Location, EstablishedYear
    - Customers who purchase vehicles are identified by CustomerID, Name, Address, Contact Information, etc.
    - Transaction identified by TransactionID, VehicleID, CustomerID, CompanyID, Sale Date, Total Price, etc.
    - Company- Vehicle: Represents the relationship between companies and the vehicles they sell.
    - Each company can sell multiple types of vehicles, and each vehicle can be sold by multiple companies.

- Customer- Transaction: Represents the relationship between customers and transactions.
- Multinational Companies are allowed to sell all types of vehicles
- Small-scale companies are allowed to sell only one type of vehicle
- A company that sells motorcycles, should not sell trucks
- Each customer can participate in multiple transactions, and each transaction involves exactly one customer.
- Company- Transaction: Represents the relationship between companies and transactions.
- Each company can participate in multiple transactions, and each transaction involves exactly one company.

03. Consider the following conference relational schema: [10]

Conference Table

reg_no	name	college_name	college_address	event_number	event_name	date
101	x	xyz	abce	1	paper presentation	xxx
102	y	abc	cded	2	poster presentation	yyy
103	z	pqr	pqrst	1	paper presentation	yyy
101	x	xyz	abce	2	poster presentation	yyy

a) Find out the type of anomaly for the following cases by considering the Conference Table. (3 Marks)

- The Student 'a' wishes to register for the conference without event details
- Assume that the poster presentation event is canceled due to some unavoidable circumstances
- The student 'x' wishes to change the name of the college since that student had registered his college name wrongly.

b) Normalize the Conference table until you reach the highest normal form. (7 marks)

04. Consider the relation R(A, B, C, D, E, F) and the corresponding functional dependencies of R. [10]

$$FD = \{A \rightarrow C, AB \rightarrow C, C \rightarrow DF, CD \rightarrow F, EC \rightarrow AB, EF \rightarrow C\}$$

a) Find the candidate key(s) of the given relation R (2 marks)

b) Find the minimal cover (6 marks)

c) Find the candidate key from the set of functional dependencies provided after applying minimal cover (2 marks)

05. The keys 10, 16, 11, 25, 3, 21, 8, 18, 15, and 9 are inserted into an empty hash table of length 10 using linear and quadratic open addressing with the hash functions h(key)=key mod 8. Show the resultant hash table of each key entry. [10]

06. Consider a database schema for employee details consisting of the following relations: [10]

employee (employee_id, name, department_id, salary)
department (department_id, department_name, location_id)
location (location_id, city, country)

a) Write the relational algebra expression to retrieve the names of employees who work in the "Finance" department located in "New York" and have a salary greater than $50,000. (2 Marks)

b) Provide a step-by-step representation in constructing of the optimized query tree. (8 Marks)

07. Consider a database system where multiple concurrent transactions are accessing a shared database. [10]

a) While one transaction is accessing a data item, no other transaction can modify that data item. Suggest a solution to implement, and explain this constraint. (3 Mark)

b) Discuss how a transaction is allowed to grant access to a data item with locks. (3 Marks)

c) Discuss how the two-phase locking protocol ensures serializability and prevents conflicts among concurrent transactions. (4 Marks)

08. Consider the following two transactions: [10]

T13:
read(A);
read(B);
if A = 0 then B := B + 1;
write(B)

T14:
read(B);
read(A);
if B = 0 then A := A + 1;
write(A).

Let the consistency requirement be $A = 0 \vee B = 0$, with $A = B = 0$ as the initial value.

a) Show that every serial execution involving these two transactions preserves the consistency of the database. (2 Marks)

b) Is there a concurrent execution of T13 and T14 that produces a serializable schedule? Justify your answer (2 Marks)

c) Convert a serial schedule of T13 and T14 to a non-serial concurrent schedule (2 Marks)

d) Convert a serial schedule of T13 and T14 to a non-serial concurrent schedule which doesn't preserve the consistency of the database. (2 Marks)

e) Show a concurrent execution of T13 and T14 that produces a non-serializable schedule. (2 Marks)

09. Consider the following customer food ordering schema. [10]

customer(custid, custname, mob, address)
restaurant(rid, r_name, location)
food(f_id, item_name, price)
cust_rest_food(custid, rid, fid)

Write SQL queries for the following:

a) Create the table for the cust_rest_food relation with key constraints. (4 Marks)

b) Set a constraint to the price of the food item so that it should not be less than 50 and should not exceed 800 (2 Marks)

c) Add a not null constraint to 'mob' in customer relation (1 Mark)

d) List the name of the food items ordered by the customer 'Sai' which costs more than 500. (2 Marks)

e) Delete the customers who don't reside in 'Chennai' (1 Mark)

10. Consider the Grade Monitoring System which maintains the grades of the students in an institute that enables the faculty to post the grade and students to view their grades. Consider, that a faculty member posts the grade of the student 'A' from the node XYZ, and the student 'A' [10]

accesses his/her grade from the node PQR. Illustrate the upholding CAP for the given scenario with suitable diagrams.