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Vellore Institute of Technology

Reg. No. : 22BCE1678

Final Assessment Test (FAT) - May 2024

Programme	B.Tech.	Semester	WINTER SEMESTER 2023 - 24
Course Title	DATABASE SYSTEMS	Course Code	BCSE302L
Faculty Name	Prof. SUKANYA G	Slot	A2+TA2
Time	3 Hours	Class Nbr	CH2023240502444
		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. You are hired as a database expert to design a comprehensive database system for a university. The university requires a robust architecture that can efficiently manage various aspects including student information, course offerings, faculty details, academic records, and administrative functions. The university also desires a scalable and maintainable system that can accommodate future growth and changes in the requirements. Illustrate the importance of the three-tier architecture for the given scenario. [10]

02. You are tasked with designing an Entity-Relationship (ER) diagram for a railway reservation system. The system is intended to facilitate the booking and management of train tickets for the passengers. Design an ER diagram that accurately represents the entities, relationships, different types of attributes, mapping cardinalities, participation constraints involved in the railway reservation system. [10]

- Passenger: Represents individuals who book tickets for train journeys identified with PassengerID (Primary Key), Name(composite attribute), DoB, Age(derived attribute), Gender, Contact Information(multivalued attribute).
- Train: Represents the trains running on different routes identified with TrainID (Primary Key), Train Name, Route, Departure Time, Arrival Time.
- Ticket: Represents the ticket booked by a passenger for a specific journey identified by *TicketID (Primary Key)*, PassengerID, TrainID, Seat Number, Booking Date.
- *Station: Represents the stations where trains halt during their journey identified by* StationID (Primary Key), Station Name, Location, etc.
- Route: Represents the sequence of stations a train passes through during its journey identified by RouteID (Primary Key), TrainID, StationID, Sequence Number, Distance between Stations, etc.
- One passenger can book multiple tickets for different journeys. One ticket is booked by exactly one passenger.
- One train follows one route. One route is followed by exactly one train.
- One route includes multiple stations. One station is included in multiple routes.

- One ticket is booked for one train journey. One train journey can have multiple tickets booked.

03. Consider the following table representing student course enrollment. [10]

Stu_ID	Stu_Name	Course_ID	Course_Name	Instr_ID	Instr_Name	Ins_Office
101	Alice	1	Mathematics	201	Prof. Smith	SM1
102	Bob	1	Mathematics	201	Prof. Smith	SM1
103	Charlie	2	Physics	202	Prof. John	JO 2
104	David	2	Physics	202	Prof. John	JO 2
105	Eve	3	Chemistry	203	Prof. Lee	LO3
106	Frank	4	Biology	204	Prof. Brown	BO4

i). Identify and justify the types of anomalies which can occur during insert/update/delete operations for the student course enrollment table (3 Marks)

ii). Normalize the student course enrollment table till it reaches the highest normal form (7 Marks)

04. Construct a B+ Tree of node size 3 for the set of key values {101, 102, 115, 116, 203, 205, 229, 301, 310, 323, 351} and update and delete the tree for each of the following sub divisions ii), iii) and iv); [10]

i). Show the tree after the insertion of all the key values. (4 marks)

ii). Dynamically update the tree for the insertion of {201} (2 Marks)

ii). Dynamically update the tree for the insertion of {208} (2 Marks)

iv). Delete {116, 229, 301} from the recently updated table and show how the tree will shrink after deletion. (2 Marks)

05. i). Imagine you're developing a banking application where users can transfer money between their accounts. One user initiates a transfer of ₹5000 from their current account to their savings account. However, just after initiating the transfer, the server crashes unexpectedly before the transaction completes. Discuss how you would ensure that the system maintains the ACID properties and transaction state integrity in this scenario. What steps would you take to guarantee that the transfer either fully succeeds or fails without leaving the system in an inconsistent state? (7 Marks) [10]

ii). Explain the different transaction states with a neat sketch. (3 Marks)

06. i). Consider the initial value of the data items A, B and C as 25000, 12000 and 10000 respectively for the schedule S1. Illustrate the log records for the schedule S1 while applying the deferred database modification and immediate database modification (6 marks) [10]

Schedule S1

T1	Read (A)
	A:=A-15000
	Write(A)
	Read (B)
	B:=B+15000
	Write(B)
T2	Read (C)
	C:=C-1500
	Write(C)

ii). Consider the schedule S2, identify and justify whether the schedule is cascadeless schedule or not. If the schedule S2 is not cascadeless then convert it into cascadeless schedule. (4 marks)

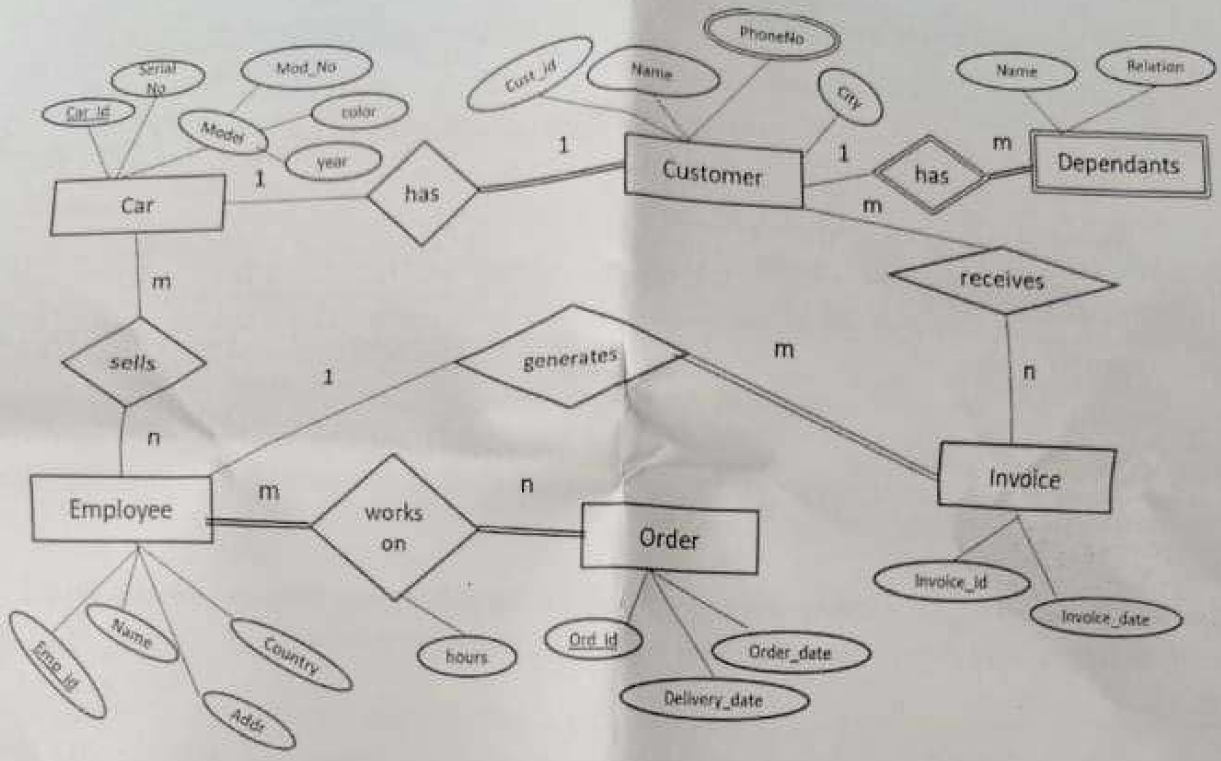
Schedule S2

T1	T2	T3
Read (A)		
A:=A-15000		
Write(A)		
Read (B)		
B:=B+15000		
Write(B)		
	Read (A)	
	A:=A-2000	
	Write(A)	
		Read (A)

07. Assume that you are asked to design a database system for a large e-commerce platform that experiences high traffic volumes and needs to efficiently handle various types of data. The platform caters to different types of users, including customers, sellers, and administrators. The database needs to support real-time inventory management, user authentication, order processing, and analytics for business insights. [10]

Outline the considerations and decision-making process for choosing between different types of NoSQL databases (document-oriented, key-value, column-oriented, and graph databases) to best suit the requirements of this e-commerce platform. Discuss the specific features, advantages, and potential drawbacks of each type in the context of this scenario. Additionally, explain how the chosen NoSQL database type aligns with the scalability, performance, and data modeling needs of the platform.

08. Convert the given Entity Relationship (ER) diagram into a relational model with step by step illustration. [10]



09. Consider the following relational schema: [10]

Passenger(PName, PId)

BusRoute(RouteNo, Source, Destination)

Drivers(DId, DName)

Travel(PId, RouteNo, DId)

Write the SQL Queries and Relational algebra expression for the following: *(5*2=10 Marks)*

i). List the name of passengers travel in the route number 151

ii). Find the number of buses runs from 'Chennai' to 'Bangalore'

iii). Display the name of drivers who drive in the route number 312 and route number 515

iv). Find the number of the passengers travelled from Chennai to Delhi and driven by the driver 'Kushal'.

v). List the source and the destination of the route number 115 travelled by the passenger 'Ram'.

10. i) For each of the following non serial schedules, transform into serial schedules and state whether it is conflict serializable or not. The actions are listed in the order they are scheduled, and prefixed with the transaction name. (3x2 = 6 marks) [10]

a). T1:R(X) T2:R(X) T1:W(X) T2:W(X)

b). T1:W(X) T2:R(Y) T1:R(Y) T2:R(X)

c). T1:R(X) T2:R(Y) T3:W(X) T2:R(X) T1:R(Y)

ii) For each of the following non serial schedules, transform into serial schedules and state whether it is conflict equivalent or not. The actions are listed in the order they are scheduled, and prefixed with the transaction name. (2x2 = 4 marks)

a). T1:R(X) T1:R(Y) T1:W(X) T2:R(Y) T3:W(Y) T1:W(X) T2:R(Y)

b). T1:R(X) T2:W(X) T1:W(X) T3:W(X)