VIT®

Vellore Institute of Technology

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Reg. No. :

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	**B.Tech.**	Semester	**Fall Semester 2024-25**
Course Code	**BCSE302L**	Faculty Name	**Prof. Gayathri Devi S**
Course Title	**Database Systems**	Slot	**D1+TD1**
		Class Nbr	**CH2024250101250**
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.

Course Outcomes

On completion of this course, student should be able to:

1. Comprehend the role of database management system in an organization and design the structure and operation of the relational data model.
2. Develop a database project depending on the business requirements, considering various design issues.
3. List the concepts of indexing and accessing methods.
4. Explain the concept of a database transaction processing and comprehend the concept of database facilities including concurrency control, backup and recovery.
5. Review the fundamental view on unstructured data and describe other emerging database technologies.

Section - I
Answer all Questions (7 × 10 Marks)

*M - Marks

Q.No	Question	*M	CO	BL
01.	Assume that M/S. Start-up has hired you as a Database Architect. After hiring, they are scheduling a job, where you are supposed to implement a file-based system for "University Information System". In the above conventional approach, application programs need to be written to meet the needs of the University. For example, a new major degree can be added so that the architect is supposed to record information about the instructors in the department, students in that major, course offerings, degree requirements, etc. Also, as time goes by, the system will acquire more files and application programs. As an experienced architect, will you proceed with the file-based approach or convince the university authority for an alternative approach? In the case of either of the two approaches, list the major advantages and disadvantages.	10	1	2
02.	a) Consider the **OrderSuppliers** (stores supplier details for each order) relation:	10	2	5

OrderID	SupplierName	SalesRep
1	Acme Corp	Bob
2	Global Parts	John
3	Acme Corp	Sarah
3	Global Parts	John

Decompose the OrderSuppliers schema to satisfy the Fourth Normal Form (4NF). Consider the common attribute as SupplierName and check if it satisfies the Fifth Normal Form (5NF). Discuss the issues in detail and identify a common attribute that doesn't violate 5NF and justify (7 Marks)

b) Consider the cars available in the Southern Indian market.

Table 1: Cars

Company	Country	Make	Model	Distributor
Hyundai	Korea	Nios	Asta, Sportz	Kun
Skoda	Germany	Kushaq	TSI Active	Gurudev
Tata	India	Altroz	XE	Gurudev
Tata	India	Nexon	XM	Gurudev
Skoda	Germary	Kushaq	TSI Monte	Kun
KIA	Korea	Sonet	HTE, HTK	Kun
KIA	Korea	Seltos	HTE, HTK	Capital Kia

Find out the type of anomaly for the following cases considering Table 1 (3 Marks)

i). Suppose *KIA*, a company from Korea, is now collaborating with *Tata* to bring the make *XM* to the Indian market with no distributor announced yet

ii). Suppose *Kun* is no more a distributor for the make Asta of Hyundai, a company from Korea

iii). Suppose Hyundai is no longer a Korean company due to its 100% procurement by Tata, a company from India.

03. Consider the following Functional dependencies 10 2 4

A→B
A→C
BD→E
BE→F
D→C
AB→F

a) Find the attribute closure for all key attributes and identify the candidate key (2 Marks)

b) Remove the extraneous attributes (2 Marks)

c) Remove the redundant functional dependencies (3 Marks)

d) With the final set of functional dependencies, find the candidate key and justify if it matches with the candidate key identified before removing the extraneous attributes and redundant functional dependencies (2 Marks)

e) List the key attributes and the non-key attributes (1 Mark)

04. (a) Consider a relation Customer of a supermarket chain with the relational schema Customer (CID, CName, City, PointsCollected). Here CID is the customer identification number that stores unique values. 10 3 3

The following query is the most frequent one;

SELECT * FROM Customer WHERE CID = v1;

Assume that the relation Customer does not have any indexes. We need to create the necessary indexes. Which of the following indexes is best suited for executing the above query efficiently? Why? Assume that the relation has a minimum of 10 records and justify your answer by constructing the appropriate index for the same. (4 Marks)

(i) A dense primary index on CID

(ii) A sparse primary index on CID

(b) A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 2 values into an empty hash table, the table is as shown below:

0	
1	
2	42
3	
4	34
5	

6	
7	
8	
9	

For the following sequence of the choices (3*2=6 Marks)
(i) 46, 32, 38, 52, 23, 33
(ii) 52, 33, 46, 23, 38, 32
(iii) 33, 23, 38, 46, 32, 52
Identify the possible order in which the key values could have been inserted in the table. Justify your answer.

05. Check if the following schedules satisfy conflict serializability and/or conflict equivalent. Draw the precedence graph for each of the following schedules and justify your answer (5*2=10 marks) — 10 4 3

S1	R1(A)	R2(A)	W1(A)	R3(B)	W2(A)	W3(B)	R1(B)	R2(B)	W1(B)	W2(B)
S2	R1(A)	W1(A)	R2(A)	W2(A)	R1(B)	W1(B)	R2(B)	W2(B)	R1(C)	W1(C)
S3	R1(A)	R2(B)	W1(A)	R3(A)	W2(B)	W3(A)	R1(C)	R2(C)	W1(C)	W3(C)
S4	R1(A)	R2(A)	W1(A)	R1(B)	W2(A)	R2(B)	W1(B)	R1(C)	W2(B)	W1(C)
S5	R1(A)	W1(A)	R2(B)	W2(B)	R3(A)	W3(A)	R1(C)	R2(C)	W1(C)	W3(C)

06. A banking application where multiple users can perform transactions on their accounts. The primary operations include transferring money between accounts, checking balances, and updating account information. Consider the below-given schedule and accomplish the following: — 10 4 4
a) Implement the Two-Phase locking protocol to overcome the issues associated with the concurrency control problems. (7 Marks)
b) Apply locks to the given schedule. Identify the issue that occurred and rewrite the schedule without conflicts(3 Marks)

T1	T2	T3
Read (A) A=A-2000 Write(A)		
		Read (A) A=A-5000 Write(A)
	Read (B) B=B+3000 Write(B)	
Read (B) B=B-1000 Write(B)		
		Read (B) B=B+2000 Write(B)

07. Design an Attendance Monitoring System that effectively manages student attendance, allowing faculty members to record and post attendance data while enabling students to access and review their attendance records. Assume a scenario where a faculty member records the attendance for a student 'S' from a device represented by node LP (laptop), and student 'S' retrieves this data from a different device, denoted as node ME (mobile). Analyze and illustrate how the system adheres to the principles of the CAP theorem (Consistency, Availability, and Partition Tolerance) in this context, supported by appropriate diagrams and explanations. — 10 5 2

Section - II
Answer all Questions (2 × 15 Marks)

*M - Marks

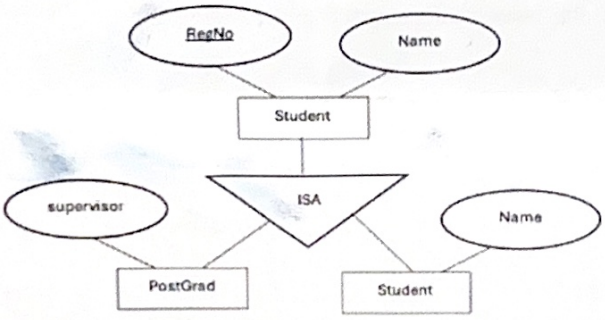
Q.No | Question | *M | CO | BL

08. a) Convert the relational schema into an Entity Relationship (ER) diagram (12 marks) — 15 1 3
Car(SerialNo, CarId, Model(Model_No, Color, Year))
Customer(Cust_id, Name, PhoneNo, City, Dependents(Name, Relation))
Employee(EmpId, Name, Address, Country)
Order(Ord_Id, Order_date, Delivery_date, Hours)
- Order to Car: Mandatory participation of Car, optional for Order
- Order to Customer: Mandatory participation for both

Invoice(Invoice_id, Invoice_date)
- Invoice to Order: Mandatory for both
Service(ServiceId, ServiceType, Cost, Duration)
- Service to Car: Optional for Car, Mandatory for Service
Payment(PaymentId, Amount, PaymentDate, PaymentMethod, Status)
- Payment to Invoice: Optional for Invoice, Mandatory for Payment
Warranty(WarrantyId, Coverage, StartDate, EndDate, Terms)
- Warranty to Car: Optional for Car, Mandatory for Warranty
Insurance(InsuranceId, Provider, PolicyNo, CoverageAmount, ExpiryDate)
- Insurance to Car: Optional for Car, Mandatory for Insurance
Accessory(AccessoryId, Name, Type, Price)
- Accessory to Car: Optional for both
Supplier(SupplierId, Name, ContactNo, Email, Address)
- Supplier to SpareParts: Optional for both
SpareParts(PartId, Name, Model, Price, AvailabilityStatus)
Feedback(FeedbackId, CustomerId, Comments, Rating, FeedbackDate)
- Feedback to Customer: Optional for both
TestDrive(TestDriveId, CarId, CustomerId, Date, Time)
- TestDrive to Car: Mandatory participation of Car, Optional for TestDrive
- TestDrive to Customer: Optional for both
Maintenance(MaintenanceId, CarId, ServiceDate, Details, Cost)
- Maintenance to Car: Mandatory for both

Note: Make sure to specify the key constraints, mapping cardinalities, participation constraints, use all types of attributes, weak entity, specialization, generalization and attribute inheritance by adding the required entities/relationships/attributes.

b) Convert the ER diagram into relational schemas. Specify the key attributes in each relational schema (3 Marks)



09. Consider the CustomerProductsOrders schema 15 2 6

Customers (CustomerID, Name, Email, Phone, JoinDate)
Products (ProductID, ProductName, Price, Stock)
Orders (OrderID, ProductID, CustomerID, OrderDate, Amount)

a) Write a SQL query and the corresponding relational algebra expression to find all product names that cost more than Rs.4587, ordered by customers who joined after January 1, 2021. [Use Cartesian Product]. Your task is to ensure that this query is optimized to run efficiently, especially if the hierarchy is deep or wide. Illustrate the step-by-step query tree for the same. Finally, write the optimal relational algebra expression. (7 Marks)

b) Write the SQL and relational algebra expression for the following: (4*2=8 Marks)

(i) Find the name of the customers who have ordered the product worth 2 lakhs

(ii) List the product details ordered by the customer sai

(iii) Count the number of orders with an amount greater than the average amount of all the orders

(iv) Count the number of orders placed on each month.

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)