amount, destination, and final delivery date. Shipped items are received into the system at a single retail center. Retail centers are characterized by their type, unique ID, and address. Shipped items arrive at their destination via one or more standard transportation events (i.e., flights, truck deliveries). These transportation events are characterized by a unique schedule number, a type (e.g., flight, truck), and a deliveryRoute.

Create an Entity Relationship diagram that captures this information about the company. Also, indicate the primary key, cardinality, and participation constraints. (8)

[This question paper contains 16 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4095 **H**

Unique Paper Code : 2342012402

Name of the Paper : Database Management Systems

Name of the Course : **B.Sc. (H) Computer Science**

Semester : IV

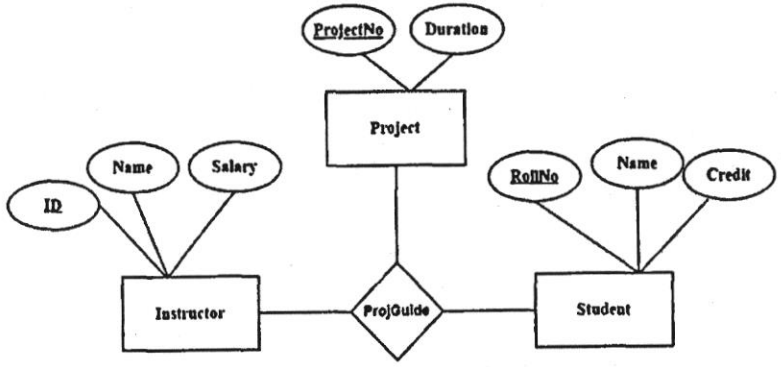
Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Attempt any **FOUR** questions from **Section B**.
4. Parts of a question should be attempted together.

Section A

1. (a) Consider the following Entity Relationship diagram (ERD) for a ternary relationship ProjGuide. Map the given ER diagram to a relation schema. (3)



(b) Consider the following SQL statements : (3)

(i) CREATE TABLE

(ii) SELECT

(iii) INSERT

(iv) CREATE VIEW

(v) DELETE

(vi) ALTER TABLE

7. (a) How does multilevel indexing improve the efficiency of searching an index file? (3)

(b) Suppose that we have an ordered file with r = 10,000 records stored on a disk. The records are of fixed size and are unspanned. The search key field in each record is V = 9 bytes long. The remaining attributes of the record are 91 bytes in total. The block size for the disk is B = 1024 bytes.

Compute the following :

(i) record length (R)

(ii) blocking factor (bfr)

(iii) number of file blocks (b)

(iv) number of block accesses required during binary search on the data (4)

(c) ABC shipping company prides itself on having up-to-date information on the processing and current location of each shipped item. To do this, the company relies on its database management system.

Shipped items can be characterized by item number (unique), weight, dimensions, insurance

TRIP (tripID, SSN,fromCity, toCity, departureDate, returnDate)

EXPENSE (tripID, accountNo, amount)

The sales office maintains multiple bank accounts. A trip can be charged to one or more accounts. Specify the foreign keys for the above relations.

(e) Consider the following relations R and S : (3)

R

A	B	C	D
15	1	15	a
20	2	25	a
25	4	20	b
15	1	25	a
30	2	20	b

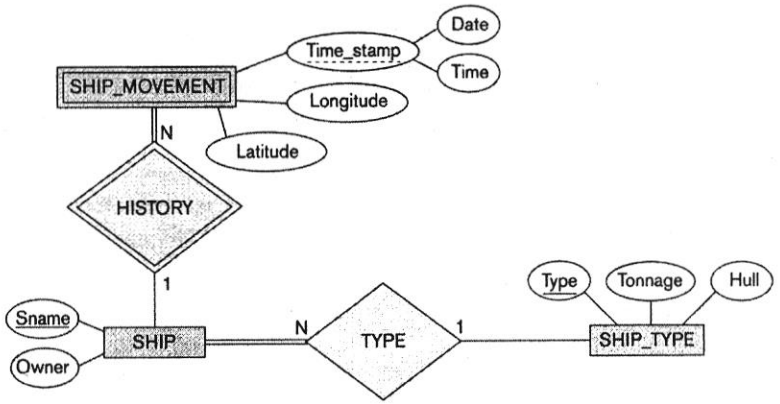
S

B	D	E
1	a	15
3	a	20
1	a	25
2	b	30
3	b	null

Show the output for the following relational statements :

(i) $R \bowtie_{R.B = S.B} S$

(ii) $R \bowtie_{R.C = S.E} S$



(c) Consider the following two tables, T1 and T2 : (6)

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	C
10	b	6
15	c	3
10	b	5

Show the results of the following operations :

(i) ρ_T (T1 X T2)

(ii) T1 – T2

(iii) T1 $\cap$ T2

6. (a) Compare and contrast the traditional file processing approach with the database approach in the context of the self-describing nature of the database system. (2)

(b) Why can a database allow at most one primary index on a file but several secondary indexes? (3)

(c) Consider a relation R with three attributes {A, B, C}. It is decomposed into relations R1 with attributes {A, B} and R2 with attributes {B, C}. State the condition (using relational algebra notation) that should be met for this decomposition to satisfy lossless-join property. (4)

(d) Considering the below given state of R(A, B, C, D) : (6)

A	B	C	D
1	2	3	4
1	2	3	5
6	7	8	2
2	1	3	4

Which of these FDs may hold on R? Justify your answer.

(i) $D \rightarrow A$

(ii) $BC \rightarrow D$

(iii) $BC \rightarrow A$

For each of the above commands, indicate whether it is a Data Manipulation Language (DML) command, Data Definition Language (DDL) command, or View Definition Language (VDL) command.

(c) Consider the following relations : (3)

Employee(empID: integer, deptID: integer, empSalary: integer, empHobby: char (20))

Department(deptID: integer, deptName: char (20), deptFloor: integer)

Which attributes will appear in the output on executing the following SQL queries?

(i) SELECT * FROM Employee E NATURAL JOIN Department D;

(ii) SELECT * FROM Employee E, Department D WHERE E.deptID = D.deptID;

(d) Consider the following relations for a database that keeps track of business trips of salespersons working in a sales office : (3)

SALESPERSON (SSN, name, joiningDate, supervisorSSN)

Timestamp	T1	T2
1	read(X)	
2	X=X+10	
3		Read(X)
4		X=X+20
5	Write(X)	
6		Write(X)
7		Commit
8	Commit	

(i) Consider the following relation StudentCourse. (3)

StudentCourse

studentID	studentName	CGPA	courseID	courseName	credits
123	Shyam	9	C118	C++	4
132	Shyam	8.5	C121	Java	4
131	Mohan	7.5	C118	C++	4
135	Vijay	8	C118	C++	4

Which of the following commands result in an update anomaly? Justify your answer.

(i) DELETE FROM StudentCourse WHERE studentID = 132

(ii) UPDATE StudentCourse SET credits = 3 WHERE courseID = 118

(c) Consider the following relation schema : (9)

Student (sNum: integer, sName: string, major: string, level: string, age: integer)

Class (cName: string, room: string, fID: integer)

Enrolled (sNum: integer, cName: string)

Write SQL statements to perform the following :

(i) Find the names of all classes that either meet in room 'R12' or have five or more students enrolled.

(ii) For all levels except 'JR', display the level and the average age of students for that level.

(iii) Find the names of students not enrolled in any class.

5. (a) Consider the following relational schema : (3)

retiredEmployee

empID	empName	basicSalary	deptName	payGrade
101	Rahul	25000	Finance	ABC
102	Rohit	35000	Admin	DEF
103	Naman	15000	Research	ABC
104	Sreejee	40000	Finance	DEF
105	Pranay	22000	Admin	PQR
106	Dheeraj	45000	Research	PQR
107	Aarav	14000	Finance	ABC

pensionGrade

payGrade	Amount
ABC	2500
DEF	3000
PQR	3500

Show the result for each of the following on the tables :

(i) SELECT deptName, COUNT (*), SUM (basicSalary)

FROM retiredEmployee

GROUP BY deptName;

(ii) SELECT empID, empName, deptName

FROM retiredEmployee

WHERE empName LIKE '_a%';

(b) Consider the following ER diagram to conceptualize a database that can be used to keep track of transport ships and their locations. (6)

(i) Map the given ER diagram into a relational schema.

(ii) Specify the primary key and foreign keys for each relation.

(f) Consider the following relational schema : (3)

Suppliers(sID: integer, sName: string, address: string)

Parts(pID: integer, pName: string, color: string)

Catalog(sID: integer, pID: integer, cost: real)

Write relational algebra expressions to perform the following :

(i) Find the names of suppliers who supply a red part.

(ii) List the IDs and names of parts with an entry in the table Catalog.

(g) Identify multivalued and composite attributes from the following complex attribute : (3)

{Hobby_stats (Name (First_name, Last_name), {Phone (Area_code, Phone_number)}, {Hobbies})}

(h) In the given schedule, what is the problem encountered due to concurrent execution of transactions T1 and T2? Assuming the initial value X=5, what will be the value of X after the schedule is executed? (3)

(i) Specify the role names for the given relationship.

(ii) Determine the cardinality ratio. Justify your answer.

(iii) Determine the participation constraint. Justify your answer.

(c) Consider the following relation for which {Car#, Salesperson#} is the primary key. Assume that all attributes are simple and atomic. Also, assume that a car may be sold by multiple salespersons.

CarSale(Car#, dateSold, Salesperson#, Commission%, DiscountAmt)

Additional functional dependencies are :

{dateSold → DiscountAmt}, {Salesperson# → Commission%} (3+4)

(i) Based on the given primary key, check whether the above schema is in 2NF. Justify your answer.

(ii) If required, normalize the given relation up to 3NF. Show all the intermediate steps.

3. (a) Consider the following relation schema : (4)

Student(SSN, Name, Major, Birthdate)

Course(CourseId, CourseName)

Enroll(SSN, CourseId, Duration)

Which of the relational model constraints may be violated by the following operations? Justify your answer in each case,

(i) Insert a record in the Enroll table.

(ii) Delete a record from the Student table.

(b) Describe the three-schema architecture with the help of a suitable diagram. In this context, give a suitable example of data independence. (3+2)

(c) State and prove the Pseudotransitive inference rule. (1+3+2)

Apply the above rule to infer ONE additional functional dependency for the given set F = {M → P, MY → P, YP → C}

4. (a) Consider a relation R(A, B, C, D, E) with the following dependencies : (2)

$\{AB \rightarrow C,\ CD \rightarrow E,\ DE \rightarrow B\}$

Is AB a candidate key of this relation? Justify your answer.

(b) Consider the following SQL statement : (4)

```
Create table Student
(Rollno INT,
Name VARCHAR(15),
Marks DECIMAL(3,2),
Age INT CHECK(Age>=17 and Age <=25),
DOB DATE);
```

Which of the following values entered for the columns holds valid? Justify your answer for each case.

(i) '14-12-2002' for DOB

(ii) 34.75 for Marks

(iii) 16 for Age

(iv) '21' for RollNo

(j) Consider the relation R = {A, B, C, D, E, F, G, H, I, J} and the set of functional dependencies F ={{A, B} → {C}, {A} → {D, E}, {B} → {F}, {F} → {G, H}, {D} → {I, J}}. (3)

(i) Find the closure of {A, B}.

(ii) Assuming {A, B} as the primary key, does the relation R exhibit partial dependency? Justify your answer.

Section B

2. (a) Consider a relation R(A, B). Is the given relation in BCNF? Why or why not? (3)

(b) Consider the following ER diagram and answer the questions that follow : (5)