Map the above Entity Relationship (ER) diagram to its corresponding relational schema. Specify all primary and foreign keys clearly.

(b) Consider two transactions, W1 and W2, executing concurrently (assuming concurrency control is not in place).

Time	W1	W2
T_0		sum:=0;
T_1		read_item(A);
T_2		sum:=sum + A;
T_3	read_item(X);	
T_4	X:=X – N;	
T_5	write_item(X);	
T_6		read_item(X);
T_7		sum=sum + X;
T_8		read_item(Y);
T_9		sum=sum + Y;

After the completion of transactions W1 and W2, name the problem that may occur when concurrent execution is uncontrolled. Justify your answer. (6)

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5587 **J**

Unique Paper Code : 2342012402

Name of the Paper : Database Management Systems

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

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. **All** parts of Question **1 (Section A)** are compulsory.
3. Attempt any **four** questions from **Section B.**
4. Attempt all parts of a question together.

Section A

1. (a) For each of the following applications, indicate whether a traditional file system or a database approach is better. Also state the reason. (3)

(i) Employee management system

(ii) Computer-aided design (CAD) tools

(b) List 3 schema definition languages that support three-schema architecture. Also specify the level of schema they support. (3)

(c) Give the Entity Relationship diagram (ERD) representation for the following entity STUDENT. The entity STUDENT consists of Rollno, Name, Address, date of birth, age and Phone number attributes. Address attribute is split into House no., Street no., City and zipcode. An entity can have multiple phone numbers and age is derived from date of birth attribute. (3)

(d) Consider the following relation: (3)

STUDENT_COURSE

SNO	CourseID	Date-of-enrollment
1	C1	2022-05-05
2	C2	2023-06-07
2	C1	2022-05-05
4	C3	2024-07-07

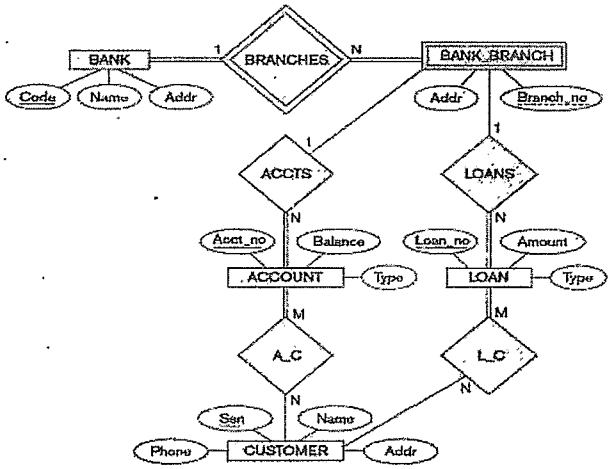
named "ABC". Also, list the corresponding Order_no.

(iii) List the Customer names who were shipped exactly two orders.

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

What is the key for R? Decompose R into 2NF. (6)

7. (a) Consider the ER diagram shown below for part of a BANK database. Each bank can have multiple branches, and each branch can have multiple accounts and loans. (9)



B = 4,096 bytes. The file records are fixed size and unspanned, with record length R = 100 bytes. A primary index for the file has ordering key field V = 9 bytes long and a block pointer P = 6 bytes long. (6)

Compute the following :

(i) blocking factor of data file (bfr)

(ii) number of file blocks in data file (b)

(iii) record size of index file (r_i)

(iv) blocking factor of index file (bfr_i)

(v) number of blocks in index file (b_i)

(vi) Total no. of block accesses needed for binary search on index file

6. (a) Specify the following queries in Relational Algebra on the following database schema : (9)

CUSTOMER (Cust_no, Cname, City)
ORDER (Order_no, Odate, Cust_no, Ord_amt)
SHIPMENT (Order_no, Warehouse_no, Ship_date)

(i) List the Order_no and Ship_date for all orders shipped from Warehouse_no 'W1'.

(ii) List the Warehouse_no from where the orders were shipped for the customer

SNo and CourseID together form a primary key. For each of the following operations, which database constraints may be violated? Justify your answer.

(i) Insert <4, 'Cl', '2022-05-05'>

(ii) Insert <4, 'C3', '2022-05-05'>

(iii) Update <4, NULL, '2023-06-07'>

(e) Consider the two relations : (3)

SUPPLIER (Sid, Sname, Pnumber)

PART (Pno, Pname)

Sid is the primary key of SUPPLIER and Pno is the primary key of PART. Pnumber is a foreign key in SUPPLIER relation.

What happens when the following clause is added with the foreign key constraints in SQL query?

(i) ON UPDATE CASCADE

(ii) ON DELETE SET NULL

(f) Consider the tables T1 and T2. (3)

T1

P	Q	R
2	20	b
1	10	b
3	30	c
5	40	a

T2

A	B	C
1	10	a
2	20	b
3	10	a
4	30	d

The domain of A, B, C are compatible with P, Q, R, respectively. Show the result for each of the following :

(i) T1 INTERSECTION T2

(ii) T1 FULL OUTER JOIN on T1.P = T2.A

(g) Convert the following relational algebraic expressions defined on two relations R(a, b, c) and S(a, d), into their equivalent SQL statements :

(i) $\pi_{c,a}(\sigma_{b=20}\ (R))$

(ii) $\pi_{b,d}((R * 5))$

- The attribute Sale-price should take the values between 10000 to 50000.

5. (a) Consider the following relational database schema. (9)

SUPPLIER (Sno, Sname)

PART (Pno, Pname)

PROJECT (Jno, Jname)

SUPPLY (Sno, Pno, Jno)

The database records information about suppliers, parts, projects and includes a ternary relationship SUPPLY between suppliers, parts, and projects.

Write SQL queries to perform the following :

(i) Retrieve the part numbers and part names that are supplied to exactly two projects.

(ii) Create a view to keep the track of project names with the total number of suppliers supplying each project.

(iii) Retrieve the project names, supplier names and part names supplied by suppliers whose name starts with letter 'R'.

(b) Suppose we have an ordered data file with r = 30,000 records stored on a disk with block size

SALE(Salesperson id, Serial no, Date, Sale price)

SALESPERSON(Salesperson id, Name, Phone)

Serial_no is the primary key in CAR relation. Salesperson_id is the primary key in SALESPERSON relation. Salesperson_id and Serial_no together form a primary key in SALE relation.

Answer the following :

(i) Specify the foreign keys in each relation (if exists).

(ii) Populate the relations with data and give an example of an updation in the SALE relation that violates the referential integrity constraints.

(iii) Write SQL query to create table SALE. (Assume that SALESPERSON and CAR tables are already created).

The following constraints should also be specified:

- Primary Key and Foreign key.

(h) Consider the following relation (3)

Q	R	S	T
Q1	50	S1	20
Q2	60	S2	20
Q1	60	S3	30

Which of the following functional dependencies are violated based on the above relation state? Justify your answer.

(i) Q->R

(ii) S->T

(iii) R->T

(i) State lost update problem that occurs if the concurrency is not controlled in transaction processing. (3)

(j) Consider the following relation. (3)

CANDIDATE(Ssn,Name,{JOB_HIST (Company, High_pos)})

Convert the relation into First Normal Form.

P.T.O.

Section B

2. (a) Describe the three-schema architecture. Also draw its diagram. Why do we need mappings among schema levels? (9)

   (b) Give any two differences between relational database schema and database state.

   A company wants to store employee records containing the following information: Employee Id, Employee name, Date of birth, Address, Department no and Project No.

   Clearly depict, making any assumptions required, the relational database schema and a possible database state for the Employee entity. (6)

3. (a) Consider a hospital management system. The system should manage information about patients, doctors, appointments, treatments, and rooms. The data requirements are summarized as follows:

   - PatientID, Name, Gender, DateOfBirth, Address, and ContactNumber are recorded for patient.
   - The data for Doctors include DoctorID, Name, Specialization, and ContactNumber.

   - Appointments information includes AppointmentID, AppointmentDate, Time, and Status. A patient can have many appointments with different doctors, and each doctor can have multiple appointments with different patients.
   - Each treatment is prescribed to a patient by a doctor. Treatment information includes TreatmentID, Description, Cost, and Date.
   - A patient can be assigned to a room, and a room can have one patient at a time. Rooms information includes RoomNumber, RoomType, and AvailabilityStatus.

   Identify all entities, their primary keys, relationships, cardinalities, and participation constraints. Design a clear ER diagram based on these requirements. (9)

   (b) Distinguish between binary relationship type and recursive relationship type. Also give an example of each relationship type. (6)

4. Consider the following relations for a database that keeps track of automobile sales in a car dealership: (15)

   CAR(Serial no, Model, Manufacturer, Price)