

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1925

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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. The paper has **two** sections **A** and **B**. **Section A** is compulsory.
3. Attempt any **four** questions from **Section B**. Each question is of **15** marks.
4. Answer **all** parts of a question together.

Section A

- 1 (a) Differentiate between DDL and DML commands. Give one example for each type of command. (3)
- (b) Define the following: Primary Key, Candidate Key and Super Key. (3)
- (c) Consider the following relations in a database: (3)
 - COURSE (CourseID, CourseName, Credits)
 - STUDENT (StudentID, Name)
 - REGISTRATION (StudentID, CourseID, Grade)Foreign Keys in relation REGISTRATION:
 - StudentID references STUDENT (StudentID)
 - CourseID references COURSE (CourseID)

P.T.O.

Identify the type of relational model constraint violated (if any) in each of the following cases:

- i. Inserting a tuple into REGISTRATION with a StudentID that does not exist in STUDENT.
- ii. Updating a tuple in STUDENT to set StudentID as NULL.
- iii. Deleting a tuple from COURSE that is referenced in REGISTRATION.

- (d) Identify and explain the problem associated with the concurrent execution of transactions T1 and T2 in the following schedule. (3)

TIME	T1	T2
1	read(W)	
2	$W = W - 40$	
3		read(W)
4		$W = W - 10$
5	write(W)	
6	read(X)	
7		write(W)
8	$X = X + X$	
9	write(X)	

- (e) State any three characteristics of the database approach. (3)
- (f) List the ACID properties of a database transaction. How are Atomicity and Consistency related? (3)
- (g) Design an entity EMPLOYEE with the following attributes using ER Diagram notation: (3)
- EmpID
 - Name
 - Address (Street, City, Zip)
 - Multiple Phone Numbers
 - Age derived from DOB

(h) Consider the following relations: (3)

- EMPLOYEE (SSN, Name, Salary, SUPRSSN, DNO)
- DEPARTMENT (DNO, DName)

In the EMPLOYEE relation:

- SUPRSSN is a foreign key referencing SSN in EMPLOYEE (supervisor relationship).
- DNO is a foreign key referencing DNO in DEPARTMENT.

Write the SQL CREATE TABLE statement for EMPLOYEE, including appropriate FOREIGN KEY constraints and clauses so that referential integrity is maintained when a referenced department (DNO) is deleted or updated.

(i) Differentiate between UNION and OUTER UNION with the help of an example. (3)

(j) Consider the following relation: (3)

A	B	C
a1	b1	c1
a1	b1	c2
a2	b1	c1
a2	b1	c3

For the given relation state, do the following functional dependencies hold (justify your answer):

- i. $A \rightarrow B$
- ii. $A \rightarrow C$
- iii. $B \rightarrow A$

Section B

2 (a) A database administrator changes the internal storage structure to improve performance, while users continue to access the database without any changes to their applications. (6)

- i. Define Data Independence.
- ii. Which concept of data independence is illustrated in the above scenario?
- iii. How does the three-schema architecture support Data Independence?

- (b) Suppose we have an ordered data file with $r = 50,000$ records, stored on a disk (9)
with block size $B = 8,192$ bytes. The file records are of fixed size and unspanned,
with record length $R = 128$ bytes.

A primary index is built on the file. The index has:

- Ordering key field size $V = 12$ bytes
- Block pointer size $P = 8$ bytes

Compute the following:

- i. Blocking factor of the data file (bfr)
- ii. Number of blocks in the data file (b)
- iii. Record size of the index file (R_i)
- iv. Blocking factor of the index file (bfr_i)
- v. Number of blocks in the index file (b_i)
- vi. Total number of block accesses required for binary search on the index file.

- 3 (a) Consider the following relation. (6)

$R = \{A, B, C, D, E\}$

and the set of functional dependencies:

$F = \{AB \rightarrow C, A \rightarrow D, B \rightarrow E\}$

Answer the following:

- i. Find the primary key of R .
- ii. Explain why R is not in Second Normal Form (2NF). Decompose R into corresponding 2NF relations.

- (b) Specify the following queries in Relational Algebra on the given database schema: (9)

PRODUCT (ProdNo, Pname, Category)

SALES (SaleNo, Sdate, ProdNo, Amount)

DELIVERY (SaleNo, StoreNo, DelDate)

- i. List the SaleNo and DelDate for all sales delivered from StoreNo 'S1'.

- ii. List all SaleNo that were delivered either from StoreNo 'S1' or StoreNo 'S2'.
- iii. List all Pname for which exactly two sales have been delivered.

- 4 (a) Consider the following relations T1 and T2 as follows: (6)

T1

A	B	C
1	10	x
2	20	y
3	30	z
4	40	x

T2

P	Q	R
2	20	y
3	10	x
5	50	z
4	40	w

Assuming that the relations T1 and T2 are union compatible, perform the following operations and show the resulting relations:

- i. $T1 \cap T2$
- ii. $T1 \bowtie_{T1.A = T2.P} T2$
- iii. $T1 - T2$

- (b) Consider a MOVIE database that stores information about the movie industry. Using the given data requirements, identify the primary keys, relationships, cardinality ratios, and participation constraints, and draw the corresponding Entity–Relationship (ER) diagram. (9)

- Each movie is identified by a title and a year of release. Each movie has a length in minutes. Each has a production company, and each is classified under one or more genres (such as horror, action, drama, and so forth). Each movie has one or more directors, and one or more actors appear in it. Each movie also has a plot outline.
- Actors are identified by name and date of birth and appear in one or more movies. Each actor has a role in the movie.
- Directors are also identified by name and date of birth and direct one or more movies. It is possible for a director to act in a movie (including one that he or she may also direct).
- Production companies are identified by name, and each has an address. A production company produces one or more movies.

- 5 (a) Differentiate between: (6)
- i. Entity Type and Entity Set
 - ii. Database Administrator and Database Designer
 - iii. Natural Join and Equi-Join

- (b) Consider the following schema: (9)

STUDENT (Sid, Sname)

COURSE (Cid, Cname)

DEPARTMENT (Did, Dname)

ENROLLMENT (Sid, Cid, Did)

The database records information about students, courses, departments, and includes a ternary relationship ENROLLMENT among students, courses, and departments.

Write SQL queries to perform the following:

- i. List the courses that have at least one student enrolled.
- ii. Produce a listing of department ids along with department names and the total number of students enrolled in each department.
- iii. Retrieve the department names, student names, and course names for those records where the student's name starts with the letter 'A'.

- 6 (a) Consider the entities SUPPLIER, PART, and PROJECT. (6)

- A Supplier supplies certain parts.
- A Project requires specific parts.
- A supplier may supply different parts to different projects, and the same part may be supplied by different suppliers for different projects.

The relationship captures the fact that a supplier supplies a particular part for a given project.

- i. Draw an ER Diagram showing a ternary relationship amongst the above entities.
- ii. Explain why this relationship cannot be replaced by three binary relationships (SUPPLIER-PART, PART-PROJECT, SUPPLIER-PROJECT).

- iii. Under what conditions can a ternary relationship be represented using binary relationships?

- (b) Consider the following relations for a bookstore database:

(9)

BOOK

ISBN	Title	Publisher	Price
B101	DBMS Concepts	McGraw Hill	500
B102	Data Structures	Pearson	450

CUSTOMER

CustID	Cname	City
C1	Amit	Delhi
C2	Neha	Mumbai

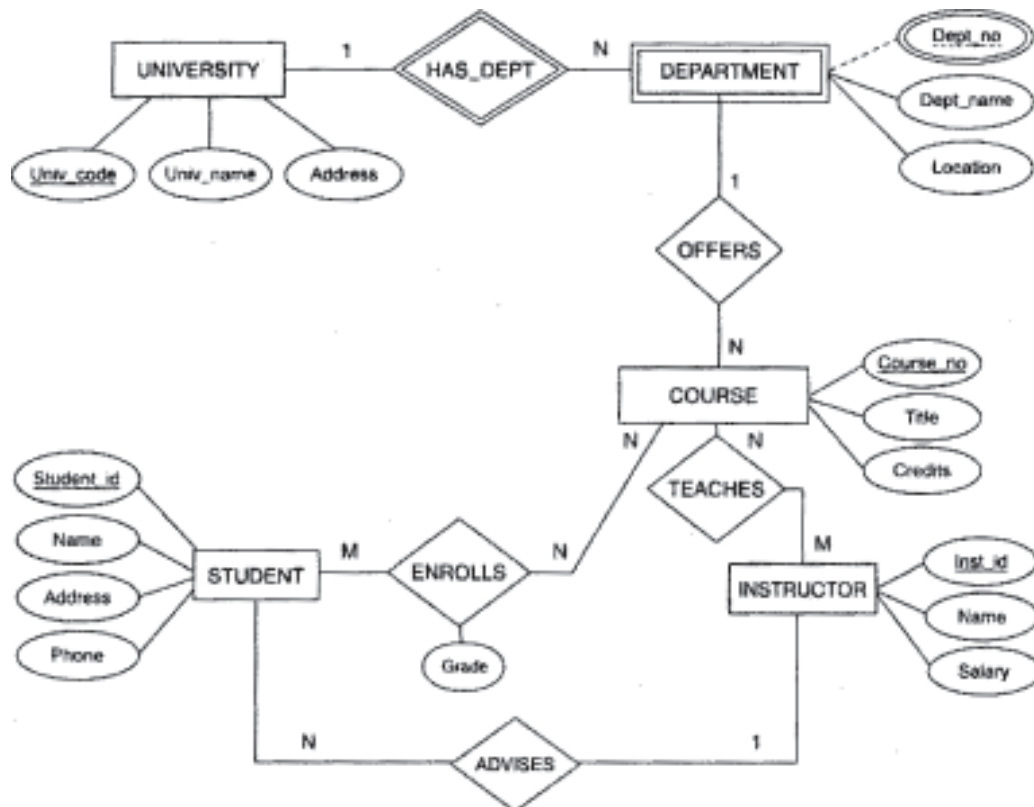
SALE

SaleID	ISBN	CustID	Sale_date	Sale_price
S1	B101	C1	2026-04-01	400
S2	B102	C2	2026-04-02	420

- Identify the primary key and foreign keys in the SALE relation.
- Give one example of an update operation on SALE that will violate referential integrity. Suggest appropriate action to handle this situation.
- Write an SQL statement to create the SALE table with appropriate primary key, foreign key constraints, and a condition that Sale_price must be between 200 and 5000.

- 7 (a) Explain the temporary update problem and the incorrect summary problem that may arise in the absence of concurrency control mechanisms. Illustrate each case with a suitable transaction schedule. (6)

- (b) Consider the ER diagram shown below for part of a University database. Each university can have multiple departments, and each department can offer multiple courses. Each course can be enrolled in by multiple students and taught by multiple instructors. Each student is advised by one instructor. (9)



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