Examination	**: End-Semester Examination – May/June 2025**
Name of the Course	**: B.Tech. (IT & Mathematical Innovations)**
Name of the Paper	**: DSC–9 Data Base Management Systems**
Unique Paper Code	**: 312210240 3**
Semester	**: IV**
Duration	**: 3 hours**
Maximum Marks	**: 90**

Instruction to students : All questions are compulsory. Internal choices are provided within certain questions.

---

1. Attempt the following questions: **(3 x 10=30 Marks)**

   a. Explain physical and logical data independence with suitable examples.
   b. Discuss the concept of entity integrity and referential integrity constraints.
   c. Define data integrity and data constraints. Why are they important?
   d. Explain the terms: primary key, super key, and candidate key with examples.
   e. Describe Armstrong's inference rules and their role in relational design.
   f. What is union compatibility? Why is it essential for UNION, INTERSECTION, and DIFFERENCE operations?
   g. Define Lossless join property with a suitable example.
   h. What is the purpose of the CASCADE and RESTRICT options in DROP SCHEMA?
   i. What are deletion anomalies? How can they be avoided?
   j. Differentiate between Network Data Model and Object-Oriented Data Model

2. Attempt any 4 of the following questions : **(5 x 4=20 Marks)**

   a. Explain the three-schema architecture of a DBMS. Why are mappings between the schema levels required?
   b. How do INNER JOIN and OUTER JOIN differ? Illustrate with examples.
   c. Define and explain the anomalies: Lost Update, Dirty Read, Non-repeatable Read, and Phantom Read.
   d. Consider the universal relation R={A,B,C,D,E,F,G,H,I,J} with functional dependencies:
      F = { {A,B}→{C}, {A}→{D,E}, {B}→{F}, {F}→{G,H}, {D}→{I,J} }.
      (i) Identify the key for R.
      (ii) Decompose R into 2NF and 3NF.
   e. Explain how TRUNCATE and DELETE differ in terms of functionality and performance with examples.

3. **Smart City Management System.** **(10 x 2=20 Marks)**

A smart city project includes managing various services like electricity, water, waste, transport, and surveillance.

- Each service is operated by a different department with assigned employees.
- Citizens can raise complaints and request services.
- The system keeps track of resource usage (like electricity units), billing, and emergency alerts.
- Employees may specialize as engineers, technicians, or administrators.
- Surveillance systems include sensors, cameras, and alert systems with their own attributes.

a. Design an EER diagram capturing all key entities, relationships, and specializations/generalizations.. State any assumptions you make and that justify your EER design choices.

b. Map the EER schema into a relational schema. Justify your choice of mapping options.

4. Attempt any 4 Considering the relation schemas as follows : **(5 x 4=20 Marks)**

STUDENT(StudentID, Name, Dept, Year)
COURSE(CourseID, Title, Dept)
ENROLL(StudentID, CourseID, Grade)
PROFESSOR(ProfID, Name, Dept)
TEACHES(ProfID, CourseID, Semester)

Write the relational algebra query and SQL answers for the following:

a. Retrieve names of all students who enrolled in the course titled "Database Systems".
b. Show the names of students who are enrolled in all the courses taught by a professor with ProfID = 101.
c. List all students who are not enrolled in any course.
d. List names of students who are in the same department as their professor (using TEACHES and ENROLL).
e. Write a query to find students who are enrolled in all courses offered by the "IT" department.