



COMSATS UNIVERSITY ISLAMABAD (CUI)  
DEPARTMENT OF COMPUTER SCIENCE  
TERMINAL EXAMINATION FALL 2025  
BS (CT, SE, DS, CS, AI) – IV SEMESTER

Course: CSC270 - Database Systems, Instructors: Sadia Maryam, Waqas Ali, Muhammad Haris, Rubina Adnan, Nusrat Shaheen. Maximum Marks: 50, Dated: 22/12/2025. Time Allowed: 180Min

- All questions are self-explanatory and require no further explanations during exam time.
- Return the question paper along with the answer sheet.

**[CLO-1]: Explain database concepts and principles. [06 Marks]**

1. Answer the following questions:

1.1.: A hospital system stores patient records in files. When doctors update patient information, different departments end up with inconsistent versions. The management wants to move to a DBMS environment with a proper data model and schemas. Explain how adopting external-conceptual-internal (three-schema architecture) solves the hospital's problem.

1. What each schema represents ✓
2. How data independence helps ✓
3. How it prevents inconsistent information across departments ✓

**[CLO-2] Apply the concept of domain and tuple relational calculus. [06 Marks]**

2. Given the following schema, write the queries for the following: -

- Customer(CID, CName, City)
- Order(OID, CID, Amount, Status)
- Delivery(OID, DriverID, DeliveryDate)

1. Retrieve the names of customers whose orders are delivered. ✓
2. Retrieve the names of customers whose total order amount is greater than 10,000. ✓
3. Retrieve customers who have placed at least one order but have no delivery recorded yet.

**[CLO-3] Apply data modeling and normalization techniques to design database for small to medium**

**[15+12]**

3. Students must use the complete EduCare University case study to design a detailed ERD and then extend it into an Enhanced ERD (EERD). Based on the description, they are required to identify all entities, their attributes, primary keys, and relationships along with appropriate cardinalities and participation constraints. Students must also highlight any weak entities, composite or multivalued attributes, and all generalization/specialization structures (including disjoint, overlapping, and total/partial constraints).

Finally, the EERD must be accurately transformed into a complete relational database schema.

EduCare University is a large multi-campus institution planning to build a centralized database system that streamlines both academic and administrative operations across all its campuses. Each campus is uniquely identified by a CampusID and CampusName, along with a detailed address containing StreetNo, City, and PostalCode. Campuses may also store several contact numbers and manage multiple departments. Every department operating within a campus is characterized by a DepartmentID and DepartmentName, and is responsible for administering various academic programs.

Each academic program offered by a department includes attributes such as ProgramID, ProgramName, and DurationYears, and every student must be enrolled in exactly one of these programs. Students are identified using a StudentID, their full name (FirstName, MiddleName, LastName), CNIC, and DateOfBirth. Faculty members are similarly described by FacultyID, their FullName, JoinDate, and multiple academic qualifications. Programs consist of several courses, where each course carries a CourseID, CourseName, and CreditHours. These courses may be offered multiple times across different semesters and academic years, and each course offering must be taught by exactly one faculty member. Students register for these course offerings, and the system records enrollment details such as EnrollID, EnrollmentDate, and Grade.

The university also maintains employee information in a generalized STAFF entity, storing StaffID, Name, and HireDate. This entity is specialized into two disjoint and total subclasses: Academic Staff (Faculty) and

Administrative Staff Academic Staff includes attributes such as Specialization and ResearchArea, whereas Administrative Staff includes attributes like PositionTitle and OfficeAssignment. Additionally, there is an overlapping subclass called LabAssistant for faculty members who also work part-time in laboratories, with LabHours as an additional attribute. Finally, the university supports optional on-campus housing for students, and hostel information is maintained using HostelID, RoomNo, and Capacity.

4. By considering the concepts of normalization in DBMS answer the questions given below by normalization up to the 3rd normal:

4.1. Write all FDS, find candidate keys and Normalize up to 3rd Normal Form [4]

StudentID	StudentName	RoomNo	HostelName	WardenName	FeeMonth	FeeAmount
201	Ali	R12	BoysHostel	Mr. Tariq	Jan	9000
201	Ali	R12	BoysHostel	Mr. Tariq	Feb	9000
202	Ayesha	R14	GirlsHostel	Ms. Sana	Jan	8500

4.2.

A	B	C	D	
1	X	P	T	i. Find All Functional Dependencies from given Dataset [2]
1	X	P	T	ii. Find all possible candidate keys. [1]
2	M	Q	U	iii. Find prime and non-prime attributes. [1]
2	M	Q	U	iv. Check relation is in which normal form. [1]
3	K	R	V	

4.3. Relation M(RollNo, CourseCode, Instructor, Dept, Semester, Grade) with FDs: RollNo, CourseCode → (Grade, Semester), CourseCode → (Instructor, Dept), Instructor → Dept. you need to Normalize to 3NF; show candidate key(s), steps, and final relations. [3]

**[CLO-4]: Describe the principles of transaction management. [11 marks]**

5. Considering the concepts of transaction management, answer the questions given below:

5.1. Transaction T1 transfers \$500 from Account A to Account B. The system crashes after deducting \$500 from A but before adding it to B.

- Which ACID property ensures the database remains correct? ✓
- What happens if this property is violated? [3] ✓

5.2. In a database table Products, Product X initially has 50 units in stock. Transaction T1 begins and reads the current stock of Product X, obtaining the value 50. Before T1 completes, Transaction T2 updates the stock quantity to 30 to reflect recent sales and commits the change. When T1 reads the stock of Product X again, it now sees the value 30 instead of 50. consider this scenario, answer the following questions. [4]

- What anomaly occurs? ✓
- Why does it occur under Read Committed? ✓
- Which isolation level prevents it? ✓

5.3. Draw a timeline illustrating the operations of two concurrent transactions, T1 and T2, that could lead to the anomalies Dirty Read and Lost Update. Explain how each anomaly occurs. [4] ✓