



COMSATS University Islamabad (CUI)
DEPARTMENT OF COMPUTER SCIENCE
TERMINAL EXAMINATION SPRING - 2026
BS(CS, SE, AI, DS, CT) – III & IV SEMESTER

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FAM-BSSE054

Course: CSC270 -Database Systems

Date: June 04, 2026

Maximum Marks: 50

Time Allowed: 180 Minutes

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- Return the question paper along with the answer sheet.

[CLO1: Explain database concepts and principles 3 * 2 = 06 Marks]

Question No. 1

A university stores student records in a database system. Different users have different responsibilities: Ali manages backups and security permissions. Sara writes SQL queries to generate reports. Students only view their grades through the portal. Identify the role of each user in the database environment.

Question No. 2

A company changes the structure of the Employee table by adding a new column called Email. Existing application programs continue working without modification. Which concept of DBMS is demonstrated here? Explain briefly

Question No. 3

A hospital database contains two relations: Doctor(DoctorID, Name, Specialization) Appointment (AptID, DoctorID, PatientName). A user enters a DoctorID in Appointment that does not exist in the Doctor table. Which integrity constraint is violated?

[CLO2: Apply the concept of domain and tuple relational calculus 3 * 2 = 06 Marks]

Question No. 4: For the following scenario, you are to write relational algebra queries, against the following needs, over a small sample database. The database contains the following 4 relations.

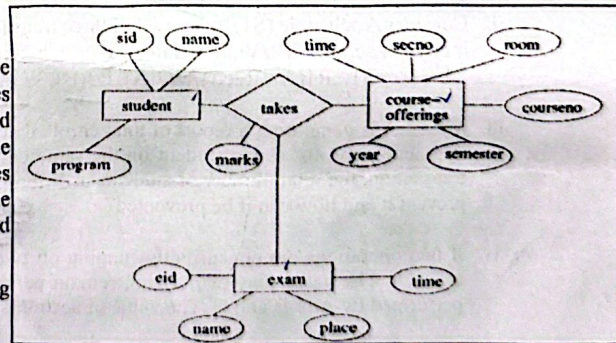
- Employees (EmployeeID (PK), EmployeeName, Department, Salary, Phone)
- Projects (ProjectID (PK), ProjectName, ClientName, Budget)
- Assignments (AssignmentID (PK), EmployeeID (FK), ProjectID (FK), AssignedDate, Role)
- Departments (DepartmentID (PK), DepartmentName, ManagerName)

- i. Find the names of all employees assigned to project "Inventory Management System"
- ii. Retrieve all projects assigned to EmployeeID = 301.
- iii. Find the total salary of employees working on each project.

[CLO3: Apply data modeling and normalization techniques to design database for small to medium size enterprise 14 + 12 = 26 Marks]

Question No. 5: Given the following Entity Relationship Diagram (ERD), modify it to include the following additional requirements. [7 * 2 = 14 Marks]

- i. Add another entity named faculty which have been assigned some Id, has name, teaches some courses that are being offered and belongs to a particular department. Identify the relationship of faculty with existing entities and update the given ER diagram. Identify the cardinalities between the entities in updated ER diagram.
- ii. Write the database schema by considering cardinalities for the generated ERD.
- iii. A university wants to maintain office allocation records for instructors. Each instructor is assigned exactly one office room, and each office room can belong to only one instructor. Extend the ER diagram and represent the relationship using proper mapping cardinality and participation constraints, also create a DB schema for this part only.
- iv. The university administration wants to categorize students into Undergraduate and Graduate students. A student can belong to only one category at a time. Extend the given ER diagram using specialization/generalization concepts and clearly specify the type of specialization used. In addition, add attributes specific to each subtype and convert into relational schema only for this part
- v. For every course offering, the system also creates several Quizzes to assess student performance during that semester. Each quiz has attributes such as quiz number, title, total marks, and date. Identify the relationship of quiz with existing entities and update the given cardinalities between the entities.



vi. The university introduces online education facilities. A course offering can now be categorized as either OnlineCourse or PhysicalCourse, while some hybrid offerings may belong to both categories simultaneously. Extend the ER diagram by including additional attributes relevant to each subtype and convert the EERD into the schema only for this part.

vii. Create a complete EERD

Question No. 6: By considering the concepts of normalization in DBMS answer the questions given below: [4 * 3 = 12 Marks]

- Assume that we have the following four tuples in a relation R (A, B, C): (p, r, u), (p, s, v), (q, t, u), (q, t, v). Write down all functional dependency (FD) that holds on R. Also find the minimal set of FDs
- Consider a relation R (A, B, C, D, E) having the following tuples. R(A, B, C, D, E) (a, x, p, a, m), (b, y, p, a, m), (c, x, q, b, n), (d, y, r, c, o), (e, z, s, c, o). To remove the redundancy and anomalies table needs to be decomposed into smaller tables. Relation R is decomposed into following relations, in multiple combinations. (R1(ABC), R2(CDE)) and R1(BCD, R2(DE)). Prove that the following decompositions are lossy or lossless.
- Consider a relation R(A, B, C, D, E, F, G). FDs: A, B → C, A → D, D → E, B → F, F → G, C → B. For the following sets of FDs, find out the highest degree of Normalization that holds Relation R. Show your steps. Identify the functional dependency that violates 3NF /BCNF conditions and transform the above identified form of normalization to BCNF.
- Let's consider the following table, state the normalization form of the table and normalize it up to BCNF. Mention the candidate keys for each table. After Normalization the table must be filled with respective values.

Student_Course_Record

StudentID	StudentName	Phones	CourseIDs	CourseNames	Instructors	Grades
501	Ali	0311-1111111. 0321-2222222	CS101, CS205	DBMS, OS	Ahmed, Bilal	A, B+
502	Sara	0333-3333333	CS101, CS330	DBMS, AI	Ahmed, Kamran	A-, A
503	Hamza	0345-4444444. 0300-5555555	CS205	OS	Bilal	B

[CLO4: Describe the principles of transaction management. 4 * 3 = 12 Marks]

Question No. 7: Considering the concepts of transaction management answer the questions given below:

- A bank customer transfers Rs. 10,000 from Account A to Account B. The system deducts Rs. 10,000 from Account A, but before adding the amount to Account B, the system crashes. Which ACID property is involved? What should the DBMS do?
- Consider A schedule (S1), where set of three transactions executed concurrently. Check whether the given schedule is conflict serializable/View serializable or non-serializable. Find the serial schedule against given schedule.
S1: R1(A), R2(A), W2(A), R3(B), W1(A), R2(C), R2(B), W3(B), W2(B), W1(C)
- A teacher is generating a report of total enrolled students in a course. While the report is being generated, another transaction enrolls a new student on the same course. When the teacher runs the same query again in the same transaction, the total number of students is different. Which concurrency problem is shown here? Which level can prevent it and how can it be prevented?
- If two operations are concurrently running on two different accounts, then the value of both accounts could get affected. The value may or may not remain persistent. In the given scenario explain the transaction T1 and T2 performed by A to B and C. The value of accounts will be affected or not and it will be persistent or not.

