

BCSE 3rd Year 2nd Semester Examination, 2025**Database Management Systems****Full marks: 100****Time: 3 hours****Group A[CO1: Recognize and associate the fundamental concepts of DBMS and relational model]:20 Marks**

- 1) a) Mention the characteristics of a relation in relational model. 3
- b) Specify the impact of integrity constraint on data manipulation operations. 4
- c) What are the problems of data redundancy? 2
- d) In relational algebra, implement the division operator with the help of fundamental operations. Also write down the relational calculus expression to represent the division operation of relational algebra. 5
- e) Compare outer join and outer union of relational algebra. 2
- f) Consider the relations: STUDENT(ROLL, NAME), and RESULT(ROLL, SCORE, SCORE)

Write the relational algebra and relational calculus expression to find out the name of the students who have scored less than 50 in at least one subject. 2+2

Group B[CO2: Illustrate the database using Entity-Relation Model and design the database]:20 Marks

- 2) a) i) In ER model, what is the structural constraint on binary relation? How does it influence the mapping of relations in ER diagram to relations in relational model? 7
- ii) Compare union and multiple inheritances in EER model. 3

OR

- b) i) Explain how do the constraints on generalization and specialization in EER model influence the mapping to relations in relational model. 7
- ii) Consider A, B and C are three entity sets. Explain whether ternary relation between the sets can be replaced by binary relations between each pair of entity sets or not and vice versa. 3

- 3) Draw the ER diagram for the following system:

There are number of students and teachers in a department. Students carry out projects work under the supervision of a teacher. Each student works in different project. A teacher may supervise zero or multiple projects. Details of the students (unique roll, name, phone number etc.) and teachers (unique id, name, phone number etc.) are to be stored. Project information like, unique project id, title, start date, report submission date etc. are to be maintained. Research articles may be published based on the work of individual project or merging the works of multiple projects. For such articles authors will be associated students, some of the associated

supervising teachers and additional teachers. For such articles information like, unique article id, title, authors, where and when published are to be stored. System must also be able to find out the supervising teacher for a student, students supervised by a teacher, what are the articles corresponding to a project.

Specify, how will you implement the relations of your ERD?

6+4

Group C[CO3: Analyze the functional dependency and design the database]:20 Marks

- 4) Each Project has unique proj_id. For each project, following information is to be stored in project schema: proj_id, proj_title, funded_by, fund_amount, start_date, end_date, coordinator_info, staff_info.

coordinator_info includes unique coord_id, coord_name, dt_bth and e-mail.

staff_info includes unique staff_id, staff_name, designation, pay, allowance, e-mail.

A project can have multiple coordinators and multiple staff members.

Consider the following FDs:

proj_id $\rightarrow$ proj_title, funded_by, fund_amount, start_date, end_date

coord_id $\rightarrow$ coord_name, dt_bth and e-mail

staff_id $\rightarrow$ staff_name, designation, e-mail

designation $\rightarrow$ pay, allowance

Normalize the project schema showing the steps so that redundancies are removed.

Identify primary and foreign key at each step.

Interpret physically whether your outcome is dependency preserving or not. 7+2+3

- 5) a) i) What is denormalization? Why it may be considered in a design?
 ii) State and prove the decomposition rule of inferring FD.
 iii) Consider a schema R(A, B, C, D) with FDs $A \rightarrow B$, $B \rightarrow C$, $C \rightarrow D$, $D \rightarrow A$. All attributes are single valued and atomic. Explain whether or not it satisfies 3NF, BCNF. 3+2+3

OR

- b) i) Armstrong's axioms are sound and complete – explain.
 ii) A schema satisfies 3NF. Explain whether it guarantees to satisfy BCNF or not?
 iii) Given a set of FDs (FDs are in canonical form), how will find out the redundant attributes in the FDs. 3+2+3

Group D[CO4: Interact with database using SQL, PL/SQL, Trigger]:25 Marks

- 6) Consider the following tables:
 STUDENT(**ROLL**, NAME)
 SUBJECT(**SCODE**, SNAME)

EXAM_ATTENDANCE(ROLL, SCODE)

RESULT(ROLL, SCODE, SCORE) : Contains data only if a student appears in the examination for the subject.

Write down one SQL statement for each of the following:

- a) Find the roll, scode pairs provided the student was absent in the examination of corresponding subject. 4
- b) Find the name of the subjects for which highest score is less than 90. 4
- c) Delete the student tuple from STUDENT provided he/she was absent in the examination for all subjects. 3
- d) Update the score if the digit in the unit place of the score is 9. 3
- e) What measures will you take at the time of creating the RESULT table so that it is ensured it can store data only if the student appeared in the examination of the subject? Write the DDL statement. 3

7) a) Consider the tables described in question 6 and further assume

SUMMARY_RESULT(ROLL, TOTAL)

Write a PL/SQL block so that for the students who have appeared in the examination for at least three subjects, their roll and total of his/her top three subject scores will be put into SUMMARY_RESULT. Assume, full marks for all the subjects are same. 8

OR

b) Consider the tables described in question 6 and further assume

BACKLOG(ROLL, SCODE)

BACKLOG stores the roll, scode pair provided the student appeared for the examination of the subject and obtained score less than 40. Write necessary triggers so that when tuple is added or updated in RESULT necessary action is taken to keep BACKLOG data in proper state. 8

Group E[CO5: Interpret and explain the principles of query optimization, transaction processing, concurrency control, recovery]: 15 Marks

- 8) a) Explain the principles of multilevel indexing. 2
- b) Compare hash join and merge join strategy. 2
- c) A DBMS follows log based recovery and steal/no force approach. A transaction does READ(X) when X is currently not in buffer and there is no free buffer available. Now, what will happen? 3
- 9) a) i) With an example show that two phase locking protocol is not free from deadlock. Explain what will happen for the schedule if time stamp based protocol is followed? 6
- ii) Explain the redo and undo operations for log based recovery? 2

OR

- b) i) With an example show that two phase locking protocol cannot ensure recoverability. How will you modify the protocol to ensure the same? 5
- ii) For concurrent environment and redo/undo log based recovery how will you prepare the lists of transactions for whom redo/undo operations to be done? 3