

## END-SEMESTER EXAMINATION

DA 512H: Databases (2025)

- Clearly state any reasonable assumption that you make
- Unless asked, direct answers without explanation or steps will be given zero.

Time: 2 Hrs.

Total Marks 80

1. [4x3=12 Marks] Consider the following relations:

- Students(sid, sname, deptid)
- Courses(cid, cname, credits)
- Takes(sid, cid, marks)

Write the relational algebra expression of the following:

- (a) to list all **student names** who are enrolled in any course worth **4 credits**.
- (b) to list **course names** taken by students who scored **more than 80 marks**.
- (c) to find the **IDs of students who have taken every course worth 4 credits**.

2. [6+4=10 Marks] Given the relation R(A, B, C, D, E, F) and the following set of functional dependencies:

$$F = \{A \rightarrow B, B \rightarrow C, AC \rightarrow D, D \rightarrow EF\}$$

Answer the following:

- (a) Compute the attribute closure  $A^+$ . Write **all steps clearly**.
- (b) Based on your result in (a), determine whether **A is a key** for R.

3. [5+4+6+3=18 Marks] Consider the following two tables:

Author(aid, name)

Book(bid, title, aid)

where every book must reference a valid author.

Answer the following:

- (a) Write the SQL statement to create the **Book** table with a **foreign key** referencing Author(aid).
- (b) Explain the difference between the following actions in foreign key constraints:

- ON DELETE CASCADE
- ON DELETE SET NULL

Provide an example scenario for each.

- (c) For each of the operations below, *state with explanation* whether it is **Valid** or a **Referential Integrity Violation**:

- (i) Inserting a book with an aid that does not exist in Author.
- (ii) Deleting an Author row that is referenced by a Book, with no ON DELETE rule defined.
- (iii) Updating Book.bid to NULL when the foreign key does not allow NULL.

- (d) Rewrite the Book table creation by adding a suitable **ON DELETE** action that prevents the violation described in part (c)(ii).

Q1

Q2

Q3

Q4

Q5

Q6

4. [3+3+4+4=14 Marks] Consider the following tables.

R	
A	B
1	2
3	2
5	6
7	8
9	8

S	
B	C
6	2
2	4
8	1
8	3
2	5

T	
A	C
7	1
1	2
9	3
5	4
3	5

Evaluate the following expressions. You should show the intermediate tables at every step.

- a)  $R \bowtie (S \bowtie T)$
- b)  $(S \bowtie R) \bowtie T$
- c)  $\pi_{A,B}(R \bowtie S) \bowtie \pi_{A,C}(S \bowtie T)$
- d)  $\pi_{A,B}(R \bowtie T) \bowtie \pi_{B,C}(S \bowtie T)$

5. [4x4=16 Marks] Consider the following relations

sid	sname	rating	age
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

sid	bid	day
22	101	10/10/98
22	102	10/10/98
22	103	10/8/98
22	104	10/7/98
31	102	11/10/98
31	103	11/6/98
31	104	11/12/98
64	101	9/5/98
64	102	9/8/98
74	103	9/8/98

bid	bname	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Sailors

Reserves

Boats

Write SQL queries of the following:

- a) Find the name of sailors who've reserved a red or a green boat.
- b) Find the name of sailors who've reserved red boats but not green boats.
- c) Find the name of sailors who've reserved a red and a green boat.
- d) Find the name and age of the oldest sailor.

6. [5+5=10 Marks]

- a) What are the advantages of Database Management Systems over traditional file-based systems?
- b) Discuss different variants of client-server architecture.