

Question 1: Advanced SQL.....[230 points]

- (a) [10 points] **Relational Language:**
Distinguish between declarative and imperative languages. Given an example for each category.
- (b) [10 points] **Query Optimizer:**
Define a query optimizer. Why is it needed in a relational DBMS?
- (c) [10 points] **SQL History:**
Give two examples of features introduced in SQL since 2000.
- (d) [10 points] **SQL:**
Distinguish between DDL and DML. In a typical database application, are most SQL statements going to use DDL or DML?
- (e) [20 points] **Database Design:**
Distinguish between logical and physical database design.
- (f) [10 points] **Syntax vs Semantics:**
Distinguish between syntax and semantics. Is SQL based on bag or set semantics?
- (g) [80 points] **Queries:**
Consider these three tables:
students : (sid, name, login, age, gpa)
enrolled : (sid, cid, grade)
courses : (cid, name)

Write a SQL query to:

- Get the average GPA of students enrolled in each course.
 - List the courses with average GPA greater than 3.9.
 - List students whose login ends with the string '@cs'.
 - Order the students enrolled in course 2 in descending order with respect to their grade.
 - List the students **not** enrolled in course 2 using a **nested query**.
 - Find all courses that have no students enrolled in them.
 - Get the name of the students with the second highest grade for each course.
 - Print the sequence of numbers from 1 to 10 using a CTE.
- (h) [10 points] **Window Functions:**
Define a window function. Why is it needed?
- (i) [10 points] **Window Functions:**
Give an example of a special window function. Illustrate how this function can be used.
- (j) [20 points] **Common Table Expressions vs Materialized View:**
Distinguish between common table expression and materialized view.

- (k) **[10 points] Outer Join:**
Distinguish between outer and inner join. When is the former operator used?
Illustrate with an example.
- (l) **[10 points] Semi Join:**
Distinguish between semi and regular join. When is the former operator used?
Illustrate with an example.
- (m) **[10 points] Anti Join:**
Distinguish between anti and regular join. When is the former operator used?
Illustrate with an example.
- (n) **[10 points] Lateral Join:**
Distinguish between lateral and regular join. When is the former operator used?
Illustrate with an example.