



# HABIB UNIVERSITY

**Database Systems**  
**CS/CE 355/373 Fall 2023**  
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## Relational Algebra

Assume we have the following schemas for the university database:

```
classroom(building, room_number, capacity)
department(dept_name, building, budget)
course(course_id, title, dept_name, credits)
instructor(ID, name, dept_name, salary)
section(course_id, sec_id, semester, year, building, room_number, time_slot_id)
teaches(ID, course_id, sec_id, semester, year)
student(ID, name, dept_name, tot_cred)
takes(ID, course_id, sec_id, semester, year, grade)
advisor(s_ID, i_ID)
time_slot(time_slot_id, day, start_time, end_time)
prereq(course_id, prereq_id)
```

**Figure 2.8** Schema of the university database.

Write down the queries for the given Set Difference relational operations:

1. Find complete records of all students who were not enrolled in any courses in Spring 2023
2. List all course IDs that were not taught by any instructor in the academic year, 2022 – 2023
3. Find the list of all courses that have no prerequisite

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Write down the queries for the given Cartesian Product relational operations:

1. Get the names of all students who have taken the course, CS-101 with grade of above 80%
2. List all course IDs and titles of the courses that a student of CE department can possibly take of his/her own department
3. Get the capacities of all classrooms in the building of ECE Department

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Write down the queries for the Rename relational operations:

1. For the given query, rename the relation to *enrolled* while updating the query:
  - $\sigma_{(semester = "Fall" \wedge year = 2022)} (takes)$
2. For the given query, rename the relation to *mentors* while updating the query:
  - $\Pi_{s\_ID}(advisors)$
3. Rename the attributes of the instructor table as follows: ID = instructorID, name = instructorName, salary = pay, while the rest remains the same, in the given query:
  - $\Pi_{name, ID}(\sigma_{dept\_name = "Physics" \wedge salary > 90000} (instructor))$
4. Now rename both the attributes names (as in part 3) as well the relation name to *professor* in the query of part 3

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