Exercise

University ER Diagram

Philadelphia University was established in 1989 as a national higher educational institution. The university is located 20 km to the north of Amman, on the road to **Jerash**. Philadelphia University has eleven faculties and a student body of more than six thousand students. Its academic staff consists of over 300 faculty members, who hold degrees from a wide range of distinguished universities.

Philadelphia University commits itself to becoming a full partner in the development of both Jordanian society and other societies at the regional and global levels. The role of science, technology, information and means of communication is becoming absolutely vital to the well-being of humanity. In the coming few years, this role is bound to become a decisive engine of growth. Relevant high–quality education, supported by problem–oriented, inter-disciplinary and inter-institutional research, is the only means of leading any society to become an active partner in the development of human civilization.

The university system consists of information about faculties, departments, instructors, and students where instructors and students are related to specific department in a faculty. The system should also store information about courses and the corresponding sections for each semester. A student is registered to specific sections for each semester which are taught by specific instructor and are given a final grade for each section.

The system should be user friendly and easy to use. System admins can manage faculties and departments by adding, modifying, and deleting faculties and departments from the university system. The study plan committee can manage courses at each department. Course schedule committee can add and modify sections in each semester, they can also delete some sections if necessary. Finally, students should be able to register to specific sections at each semester at a specific period allowed by the system.

Consider the following requirements:

1. Each Instructor in the university has an SSN, a name (first and last name), DOB, an age, a rank, a salary, an office, and a research specialty.
2. A faculty in the university consists of multiple departments and has a faculty number, a title, and a main office. A department cannot be in multiple faculties.
3. Each Department has a department number, a department name, number of registered students, and a main office.
4. Multiple instructors are designated to a specific department where each instructor belongs to one department only in a faculty.
5. Each student in the university has a Student no, SSN, a name (first and last name), DOB, an age, total hours credit, and several skills.
6. Each department consists of several Courses but a course cannot be related to multiple departments.
7. Each student has one major only which reflects the student registration to the department.

8. Each course has a course code, title, and credit hours and can have just one prerequisite course. However, the same course can be a prerequisite for multiple courses.
9. For each semester in a year, one or more sections can be opened for each course. A section is related to only one course at a semester.
10. Each section has multiple students that are registered to it. A student can register for several sections in a semester and got a grade after the semester ends.
11. A section has a section id and has one instructor only which teaches several students that are registered to that section.
12. Instructors can teach several sections or courses through the semester.
13. Each student likes some instructors but can be advised by one instructor as an academic advisor. The instructors are liked by multiple students and can advise multiple students as well.

The following are requested:

1. Design and draw an ER diagram that captures the information about the university:
   - Draw entities, relationships, and attributes.
   - Show relationship cardinality.
   - Underline the primary keys.
   - Show derived, multi-values, and composite attributes – if exist.
   - Show the week entity sets and relationship sets – if exist.
   - Show recursive relationships – if exist.
2. Design a relational schema based on the ER diagram designed in the previous point by mapping the ER design to the corresponding relational schema.
3. Write the relational algebra expressions to satisfy the following queries:
   - Find the first name, last name, and rank for all instructors in the university.
   - Find all instructors at office '333'.
   - Find all instructors who earn greater than $1000.
   - Find the first name, last name, and rank for all instructors who earn greater than $1000.
   - Find all instructors with a 'professor' rank and a specialty 'Data Mining'.
   - Find the first and last name of all instructors for the department named "Computer science".
   - Find the code of all pairs of courses and their pre-requisite.
   - Find the student number of all students having the "Development" skill
   - Find the student SSN of all students having the "Development" skill
   - Find the SSN of the advisor for each student having the "Development" skill
4. Implement the database schema using one of the relational DBMS (oracle, mysql, sql server) and add at least 5 records for each table.
5. Convert the algebra expressions from point 3 to SQL statements and run it using the DBMS.

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