Solutions for Tutorial-2 Queries - Relational Algebra - CS3700 (Odd-2021)

Note-1: In RelaX, few notations differ from standard ones (replace * with ⋈ while running these queries on RelaX). Also, use [σ condition] instead of [$\sigma_{condition}$], similarly for π and ⋈.
Note-2: Students are expected to use standard notations while writing quiz/end-sem exams.
Note-3: In Relax, the assignment (=) does not create a new relation but holds the query itself. For example, in Q-5, the theta join condition has StudentTeacher.rollNo = student.rollNo, however, since StudentTeacher is not a relation but a query placeholder, it will return an error. So in the join condition, StudentTeacher should be replaced by enrollment, giving enrollment.rollNo = student.rollNo.
Note-4: Finally, the assignment *Result* = *Query* should be written as just *Query* to get an output in Relax.
Note-5: The solutions provided demonstrate the correct way of writing the queries for assignments and quizzes. They are not meant to be run on Relax directly. However, with few modifications they can be run on the RelaX tool.

1. Find the empId and name of the CSE professors who joined before 2005
Ans.
cseDept = π_{deptId} ($\sigma_{name = 'CSE'}$ (department))
Result = $\pi_{empId, name}$ ($\sigma_{startYear < 2005}$ (cseDept $\bowtie_{(deptId = deptNo)}$ professor))

2. List the courseId(s) of courses with no prerequisites
Ans. $\pi_{courseId}$ (course) - $\pi_{courseId}$ (preRequisite)

3. List the courseId(s) of courses taught by the HOD of the EE dept in the current semester.
Ans.
hodEE = π_{hod} ($\sigma_{name = 'Electrical-Engg.'}$ (department))
currentCourses = $\pi_{courseId, empId}$ ($\sigma_{sem = 2 \wedge year = 2021}$ (teaching))
Result = $\pi_{courseId}$ (currentCourses $\bowtie_{empId = hod}$ hodEE)

4. Find the name and roll no. of the student(s) who enrolled for courses offered by a department which is not his/her parent department in the current semester.
Ans.
EnrolledStudentsDept = $\pi_{rollNo, deptNo}$ ($\sigma_{year = 2021 \wedge sem = 2}$ (enrollment * course))
StudentsDept = $\pi_{rollNo, deptNo}$ (student)
OtherDeptEnrollments = EnrolledStudentsDept - StudentsDept
Result = $\pi_{rollNo, name}$ (OtherDeptEnrollments $\bowtie_{(OtherDeptEnrollments.rollNo = student.rollNo)}$ student)

5. Find the name and roll no. of student(s) who have enrolled in a course which is taught by their advisor.
Ans.
StudentTeacher = enrollment * teaching
AdvisorCourse = (StudentTeacher $\bowtie_{(StudentTeacher.rollNo = student.rollNo) \wedge (empId = advisor)}$ student)
Result = $\pi_{student.rollNo, student.name}$ (AdvisorCourse)

6. Find the list of roll numbers of students who got S grade in all the prerequisites of CS6700
Ans.

$preReqCS6700 = \pi_{courseIdReq} (\rho_{courseIdReq \leftarrow preReqCourse} (\sigma_{preRequisite.courseId = 'CS6700'} (preRequisite)))$

$StudWhoGotSGrade = \pi_{rollNo,\ courseIdReq} (\rho_{courseIdReq \leftarrow courseId} (\sigma_{grade = 'S'} (enrollment)))$

$Result = StudWhoGotSGrade \div preReqCS6700$

7. Find the names of the professors who have taught a course at least 2 times, along with courseId(s) of such course(s)
Ans.

$coursesOfferedAtleastTwice\ (empId, courseId) =$
$\pi_{teaching.empId,\ teaching.courseId} (\sigma_{teaching.courseId = T.courseId\ \wedge\ teaching.year \neq T.year\ \wedge\ teaching.empId = T.empId}$
$(teaching \times \rho\ T\ (teaching)))$

$Result = \pi_{empId,\ name,\ courseId}\ (coursesOfferedAtleastTwice * professor)$

8. List the name(s) of the department(s) that offer only 12 credit courses.
Ans.

$CourseOfferingDepartments = \pi_{deptNo} (course)$
$Non12CreditsDepartments = \pi_{deptNo} (\sigma_{credits \neq 12} (course))$
$RequiredDepartments = CourseOfferingDepartments - Non12CreditsDepartments$
$Result = \pi_{deptNo,\ name} (RequiredDepartments \bowtie_{(deptNo = deptId)} (department))$

9. Find the employee id and name of the professors who are the senior most in the Physics department.
Ans.

Solution is not provided. Students are required to develop the solution and contact the TAs for help, if needed.

10. Find the name of the student(s) who have done a course from all the departments of the institute.
Ans.

$EnrolledStudentsDepartment = \pi_{rollNo,\ deptNo} (enrollment * course)$
$Departments = \pi_{deptNo} (\rho_{deptNo \leftarrow deptId} (department))$
$CourseFromAllDept = (EnrolledStudentsDepartment \div Departments)$
$Result = \pi_{rollNo,\ name} (CourseFromAllDept * student)$

Example Relational Scheme with RICs shown

student (rollNo, name, degree, year, sex, deptNo, advisor)

department (deptId, name, hod, phone)

professor (empId, name, sex, startYear, deptNo, phone)

course (courseId, cname, credits, deptNo)

enrollment (rollNo, courseId, sem, year, grade)

teaching (empId, courseId, sem, year, classRoom)

preRequisite (preReqCourse, courseId)