① Find the department (s) with minimum budget

(Ans.) $x = \Pi_{dept.name}(S_{lhs}(department) \bowtie_{\theta_1} S_{rhs}(department))$

$\theta_1 = lhs.department-name < rhs.department-name$
$\theta_1 = lhs.department-budget < rhs.department-budget$

$y = \Pi_{dept.name}(S_{lhs}(department) \bowtie_{\theta_2} S_{rhs}(department))$

$\theta_2 = lhs.department-budget > rhs.department-budget$

$x \setminus y$

→ x gives list of all departments with budget less than at least one other department

→ y gives list of all departments with budget more than at least one other department

→ $x \setminus y$ removes departments with budget more than at least one other department, leaving behind list of department (s) with minimum budget

② Find all departments that don't share a building with any other department

(Ans.) $x = \Pi_{dept.name}(S_{lhs}(department) \bowtie_{\theta} S_{rhs}(department))$

$\theta = lhs.department-building == rhs.department-building \wedge$
$lhs-dept.name == rhs-dept.name$

→ x gives list of all departments which share building
with only themselves and no other department

③ Find all faculty members who teach exactly one course

(Ans) $x = \Pi_{ID} (\text{teaches})$

$y = \Pi_{ID} (S_{lhs} (\text{teaches}) \bowtie_\theta S_{rhs} (\text{teaches}))$

$\theta = lhs.\text{faculty-id} == rhs.\text{faculty-id} \land$

$lhs.\text{course-id} \; != \; rhs.\text{course-id}$

$x \setminus y$

→ x gives list of all faculty members
→ y gives list of all faculty members who teach
more than 1 course (faculty id same, course id not same)
→ x\y removes all faculty members who teach
more than 1 course, leaving behind
list of all faculty members who teach only
1 course.

④ Find all courses that have more than 1 pre-requisite.

(Ans) $x = \Pi_{course-ID} (S_{lhs} (\text{prerequisites}) \bowtie_\theta S_{rhs} (\text{prerequisites}))$

$\theta = lhs.\text{course-id} == rhs.\text{course-id} \land lhs.\text{prerequisite-id}$
$!= rhs.\text{prerequisite-id}$

→ x gives list of all courses for when lhs & rhs course ids
are same, but prerequisite ids are different, so
giving list of all courses who have more than 1 prerequisite

⑤ Find all courses that are prerequisites for more than 1 course.

(Ans.) $x = \pi_{lhs.\ prerequisite-id}\ (\rho_{lhs}\ (prerequisites) \bowtie_\theta$
$\qquad\qquad\qquad\qquad\qquad\qquad \rho_{rhs}\ (prerequisites))$

$\theta = lhs.\ prerequisite-id == rhs.\ prerequisite-id \wedge$
$\qquad lhs.\ course-id\ != rhs.\ course-id$

→ x gives list of all courses ~~such that~~ which
are prerequisites to more than 1 course
such that lhs prerequisite id is same as
rhs prerequisite id but lhs course id
is different from rhs course id.

⑥ Find all students who are not registered for
any course in 2018.

(Ans.) $x = $ ~~$\pi_{ID}\ (takes)$~~ $\pi_{ID}\ (student)$

$y = \pi_{ID}\ (\sigma_{year\ =\ 2018}\ (\ takes\ ))$

$x \setminus y$

→ x gives list of all students
→ y gives list of all students who are taking
a course in 2018
→ $x \setminus y$ gives list of all students who aren't
registered for any course in 2018

⑦ Find all students who have repeated a course

(Ans.) $x = \pi_{ID} (\text{Sets (takes}$

$x = \pi_{student-ID} (\text{Sets})$

$x = \pi_{student-ID, course-ID} (\text{Sets (takes)} \bowtie_\theta \text{Srhs (takes)})$

$\theta = $ lhs. student-ID $==$ rhs. student-ID $\wedge$ ltap
lhs. course-ID $==$ rhs. course ID $\wedge$ lhs. year $!=$
rhs. year

→ x gives list of all students (where lhs student ID = rhs
student ID, lhs course ID = rhs course ID, but
lhs year not same as rhs year)
who repeated the same course in different
years.