1) Consider the following relational schema; the schema describes a database containing data about theses carried out by students of a master degree. Theses have supervisors and co-supervisors. The underlined attributes denote the primary keys of the relations. The column Prof# in the relation Theses indicates the professors that are supervisors.

   Students (S#, FName, LName, Street, City, Phone#)
   Theses (T#, Title, Topic, Prof#, S#, Evaluation)
   Professors (Prof#, PName, Rank, Phone#, Dept#)
   Theses-Co-Supervisors (T#, Prof#)

(a) (pt.10) Determine which is the SQL CREATE TABLE command for creating the relation Theses that best reflects the semantics (in terms of keys and foreign keys) of the relation Theses:

(i) CREATE TABLE Theses
    (T#: INTEGER,
     Title: VARCHAR (30),
     Topic: CHAR (20),
     Prof#: INTEGER,
     S#: INTEGER,
     Evaluation: VARCHAR (400));

(ii) CREATE TABLE Theses
     (T#: INTEGER PRIMARY KEY,
      Title: VARCHAR (30),
      Topic: CHAR (20),
      Prof#: INTEGER REFERENCES Professors,
      S#: INTEGER,
      Evaluation: VARCHAR (400));

(iii) CREATE TABLE Theses
      (T#: INTEGER PRIMARY KEY,
       Title: VARCHAR (30),
       Topic: CHAR (20),
       Prof#: INTEGER REFERENCES Professors,
       S#: INTEGER REFERENCES Students;
      Evaluation: VARCHAR (400));

(b) (pt. 15) Determine which is the correct SQL CREATE TABLE command for creating the relation Theses-Co-Supervisors:

(i) CREATE TABLE Theses-Co-Supervisors
    (T#: INTEGER PRIMARY KEY,
     Prof#: INTEGER PRIMARY KEY);

(ii) CREATE TABLE Theses-Co-Supervisors
     (T#: INTEGER REFERENCES Theses,
      Prof#: INTEGER PRIMARY KEY);

(iii) CREATE TABLE Theses-Co-Supervisors
      (T#: INTEGER REFERENCES Theses,
       Prof#: INTEGER REFERENCES Professors,
       PRIMARY KEY (T#, Prof#));
2) (pt. 25) Consider relation Theses-Co-Supervisors (defined in point (1) above) and suppose that we want to implement the following semantics with respect to referential integrity:
- When a student is removed, all information about his/her thesis co-supervisors must be removed.
- A professor cannot be removed from the relation Professors if he/she is a co-supervisor of some thesis.

Specify the CREATE TABLE command for the relation Theses-Co-Supervisors that implements this semantics.

3) (pt. 20) Let R and S be two relations with the same schema U. Let schema U be as follows:
U= \{A, B, C\}. Assume that all attributes in the schema have as domain the set of integer numbers.
Consider the following query expressed in the relational calculus:
\{t: U \mid t.A=5 \land t \in R \land \neg t \in S\}
Is this query safe?

4) (pt. 10) Consider the query given in point (3) above.
Can this query be expressed in relational algebra?
If so, write an equivalent relational algebra expression.

5) (pt. 10) Consider the following two table definitions:
CREATE TABLE Tab1
(A: INTEGER PRIMARY KEY,
B: INTEGER,
C: INTEGER
FOREIGN KEY (B, C) REFERENCES Tab2 MATCH FULL);

CREATE TABLE Tab2
(B: INTEGER,
C: INTEGER,
D: INTEGER,
PRIMARY KEY (B, C));

Suppose that these two tables have the following contents (the symbol ? denotes null values):

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>500</td>
<td>?</td>
</tr>
<tr>
<td>20</td>
<td>700</td>
<td>100</td>
</tr>
<tr>
<td>30</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>40</td>
<td>300</td>
<td>600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>850</td>
<td>3000</td>
</tr>
<tr>
<td>600</td>
<td>400</td>
<td>1700</td>
</tr>
<tr>
<td>700</td>
<td>100</td>
<td>1900</td>
</tr>
<tr>
<td>900</td>
<td>20</td>
<td>1200</td>
</tr>
</tbody>
</table>

Indicate the tuples of table Tab1 which do not verify the referential integrity constraint.

6) (pt. 10) Consider table Tab1 given in point (5) above. Suppose that the following constraint is added to the definition of table Tab1: CHECK (B>C).
Indicate the tuples of table Tab1 which violates this constraint.