Problem 1. [20pts]
Consider the following database for the music store "Championship Vinyl":

- Albums(album_id, title, year, label_id, artist_id, price)
- Songs(song_id, album_id, title, duration)
- Artists(artist_id, name, dob)
- Labels(label_id, name, year_created, country)
- Sales(album_id, date, copies)

The Albums relation stores information about albums and the Songs relation about songs. The Artists relation stores data about artists and the Sales relation stores how many copies of a particular album was sold each day (only for the albums that were sold that day). The underlined attributes are the keys of each relation.

Write the following queries in SQL:

1. Find the name of the artists that released an album in 2014 using a label company from Canada.
2. Find the name of the artists that have created more than 100 songs.
3. List the name of artists that have released more than two albums with at least 13 songs in each one of them.
4. Find the artists who have produced albums with all the label companies in the US.
5. (Only for CS 660, 5pts) Find the artist(s) who has produced the albums with the maximum average profit.

Problem 2. [30pts]
Consider the following relational schema.

- Student(sid:integer, sname:string, age:integer, year_started:date, gpa:real)
- Dept(dname:string, numphds:integer)
- Prof(pid:integer, pname:string, dname:string)
- Course(cno:integer, cname:string, dname:string)
- Major(dname:string, sid:integer)
- Section(dname:string, cno:integer, sectno:integer, pid:integer)
- Enroll(sid:integer, grade:real, dname:string, cno:integer, sectno:integer)

Write the following queries in SQL:

1. Find the names of students who are enrolled in at least one course from both the "Computer Science" and the "Biology" departments.
2. Find the name(s) of the oldest first year student (students started in 2015).
3. Find the department(s) that have the highest average gpa for the students that have a major in these departments. (The average gpa of a department is computed based on the students that declared a major for this department.)
4. Find the ids, names, and gpas of the students who took all the courses offered by Prof. Smith.
5. Find the name, gpa, and the average grade of students with gpa ≥ 3.0 who also have an average grade of at least 3.2 from all "Computer Science" courses he/she has enrolled into.

Problem 3. (Based on Exercise 5.10) [20pts]

Consider again the following relational schema. An employee can work in more than one department; the pct time field of the Works relation shows the percentage of time that a given employee works in a given department.

Emp(eid: integer, ename: string, age: integer, salary: real)
Works(eid: integer, did: integer, pct time: integer)
Dept(did: integer, dname: string, budget: real, managerid: integer)

Write SQL integrity constraints (domain, key, foreign key, or CHECK constraints; or assertions) to ensure each of the following requirements, considered independently. You have to give the CREATE TABLE statements for each relation and you can modify it to add constraints if needed.

1. Employees must make a minimum salary of $1000.
2. Every manager must be also be an employee.
3. The total percentage of all appointments for an employee must be under 100%.
4. A manager must always have a higher salary than any employee that he or she manages.

Problem 4.(Based on Exercise 19.10) [30pts]

Suppose you are given a relation R=(A ,B ,C ,D). For each of the following sets of FDs, assuming they are the only dependencies that hold for R, do the following: (a) Identify the candidate key(s) for R. (b) State whether or not the proposed decomposition of R into smaller relations satisfies the (i) lossless join and (ii) dependency preserving decomposition conditions, briefly explain why or why not.

1) $B \rightarrow C, D \rightarrow A$; decompose into BC and AD.
2) $A B \rightarrow C, C \rightarrow A, C \rightarrow D$; decompose into ACD and BC.
3) $A \rightarrow BC, C \rightarrow AD$; decompose into ABC and AD.
4) $A \rightarrow B, B \rightarrow C, C \rightarrow D$; decompose into AB and ACD.
5) $A \rightarrow B, B \rightarrow C, C \rightarrow D$; decompose into AB, AD and CD.

Problem 5. Only for CS 660 [15pts]

Consider the relation R=(A, B, C, G, W, X, Y, Z). Assuming the following set of FDs on R: $F = \{ XZ \rightarrow YZB, YA \rightarrow CG, C \rightarrow W, B \rightarrow G, XZ \rightarrow G \}$. 

a) Compute the minimal cover $F_c$ of $F$.
b) Is the dependency $XZA \rightarrow YB$ implied by $F$?
c) Is the decomposition into $XZYAB$ and $YABCGW$ lossless?
d) Is the above decomposition dependency preserving?