Name: _____ , _____
(Family name) (Given name)

Student ID: _____

Signature: _____

THE UNIVERSITY OF NEW SOUTH WALES
Final Exam

COMP9311
Database Systems

Session 2, 2017

- Time allowed: **2 hours** + **10 mins** reading time
- Total number of questions: **5**
- Total number of marks: **60**
- Answer **all** questions.
- You can answer the questions in any order.
- Start each question on a **new page**.
- Answers must be written in ink.
- Answer these questions in the script book provided.
- Do **not** write your answer in this exam paper.
- If you use more than one script book, fill in your details on the front of **each** book.
- You may **not** take this question paper out of the exam.

Section A: ER Diagram

Question 1 (12 marks)

Draw an ER diagram for a university with the following specifications:

The university offers many degree programs. Each degree program is identified by a program code. For each degree, we store its standard duration and number of courses required to complete it. Each course is identified by a course code. We also need to record prerequisite[1] and corequisite[2] courses for each course. A course may have zero or more prerequisite and corequisite courses. Each course may be a prerequisite and/or corequisite course of zero or more courses. For each course, we also record its unit of credits, and the degrees related to it. Each course is related to at least one degree but may be taken in more than one degree. The university offers three semesters every year. For each course offered in each semester, we need to record the name of its lecturer and name of the lecture theatre. A lecturer may teach zero or more courses each semester. For each lecturer, we record his/her staff id, age and salary. Every student is enrolled in exactly one degree and may take zero or more courses each semester. We record their student ids, names, addresses, and marks obtained in each course.

State your assumptions clearly.

[1] A prerequisite course is a course that is required prior to taking an advanced course.
[2] A corequisite course is a course required to be taken in conjunction with another course.

Section B: Relational Mapping and SQL Schema

Question 2 (12 marks)

(a) (**4 marks**) Convert the ER Diagram shown in Figure 1 below into relational model. Clearly specify the primary key of each relation (table) and, if any, foreign keys and to which table they refer to (use similar notation as the one in Figure 2 below).

(b) (**8 marks**) Then write SQL statements to create the generated tables. You must enforce all the constraints that are apparent from the ER diagram shown in Figure 1 below. Use appropriate data types for the attributes.

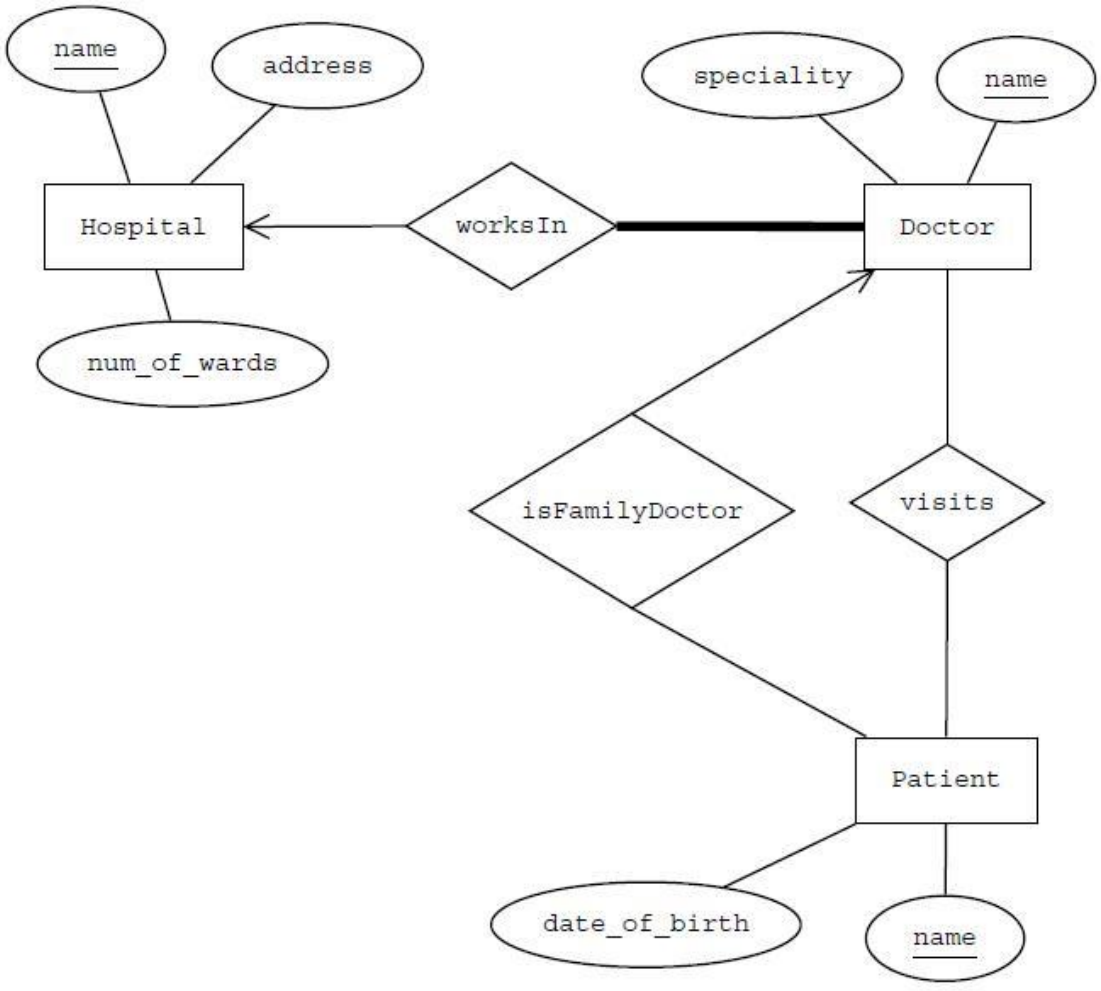

Figure 1: An ER Diagram for a Hospital Database

Section C: Relational Algebra / SQL Queries

Question 3 (12 marks)

Consider the relational model shown in Figure 2 below:

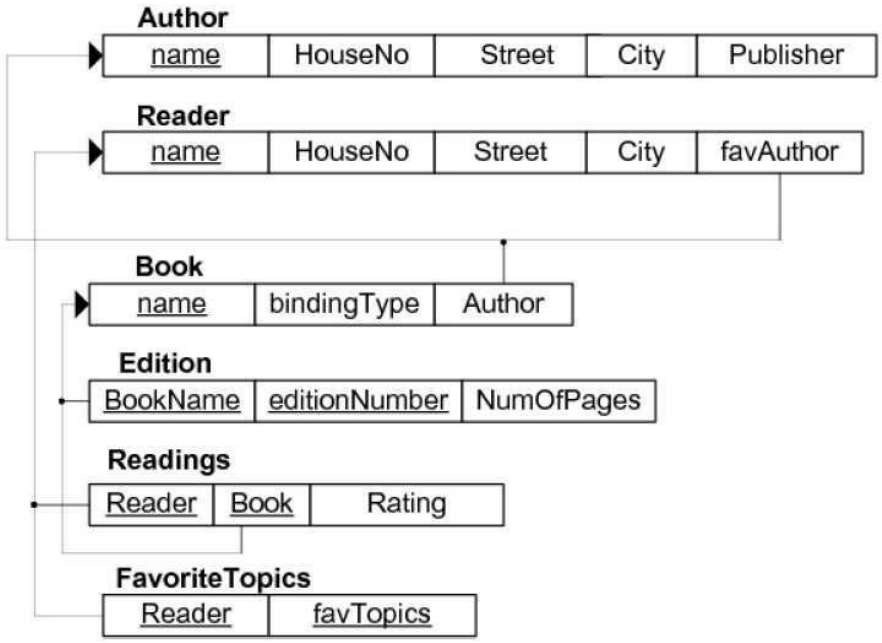

Figure 2: Relational Model for Books Database

The **Readings** table records the name of each book a reader has read and the rating she/he has given. The **FavoriteTopics** table stores the favorite topics for each reader (it does not give the information about favorite books of readers). For instance, a reader called James might have favorite topics "science fiction" and "humour".

(a) (**6 marks**) Write **relational algebra expressions** for the following queries.

i. (**3 marks**) For each author, display the number of readers who like the author. We say that a reader likes an author if the author is his/her favorite author. **Note:** We need to display 0 for the authors who are not liked by any reader.

ii. (**3 marks**) Find the name of every book such that at least two readers who like the author of the book have given it a rating less than 5.

(b) (**6 marks**) Write **SQL queries** to answer the following;

i. (**3 marks**) For each book, display the number of its editions.

ii. (**3 marks**) For the book(s) with the greatest number of editions, find the name of their publishers. If the answer includes more than one publisher, include all of them.

Section D: PL/SQL

Question 4 (12 marks)

Consider the Books database relational model shown in Figure 2 above. Assume that rating, editionNumber, NumOfPages and HouseNo attributes are **INTEGER** and all other attributes are **TEXT.** Answer the following questions:

(a) (**4 marks**) Write a **function** that takes the name of a reader as a parameter and returns the names of all authors living in the same city as that of the readers. If there is no such author, the function should return "**No such author!**". If the reader does not exist in our database, an exception must be raised with an appropriate message. Use the following function header:

create or replace function sameCity (rname text) returns setof text

(b) (**4 marks**) Write a **function** that takes the name of a reader as a parameter and returns the number of books she/he has read (the **Readings** table records the books each reader has read). If the reader does not exist in the **Reader** table, -1 must be returned. Use the following function header:

create or replace function booksRead (rname text) return integer

(c) (**4 marks**) Write a **trigger** such that on any insert or update on the **Readings** table, it checks that the name of book and the name of reader are valid (the name of book and reader exists in the **Book** and **Reader** tables, respectively). The trigger must also ensure that the value of rating is valid. More specifically, a NULL value for the rating is allowed but any non-NULL value must be between zero and ten.

Section E: Normalization

Question 5 (12 marks)

Consider the ER diagram in Figure 3 below and answer the following questions:

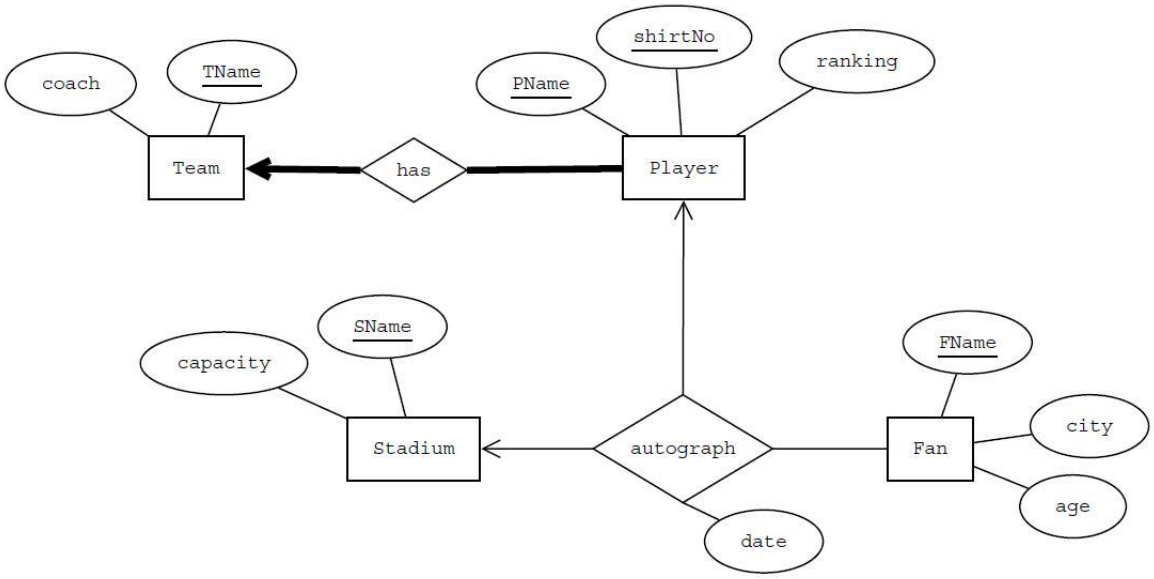

Figure 3: Relational Model for Autograph Database

(a) (**5 marks**) List all the functional dependencies in the **Autograph** database. Include only the dependencies that are apparent from the ER diagram. Write down any assumptions you make.

(b) (**7 marks**) A person who has never taken any database course has created a table called **AUTOGRAPH** as shown below;

```
AUTOGRAPH:
(TName,coach,PName,shirtNo,ranking,SName,capacity,date,FName,city,age)
```

Help her/him to generate a lossless decomposition of this table into **Boyce-Codd** normal form. Use normalization theory and show all important steps. After decomposition, determine **all** candidate keys of every table.

END OF EXAM PAPER