**Beijing-Dublin International College**

---

**SEMESTER II FINAL EXAMINATION - 2016/2017**

---

**School of Computer Science**

**COMP2004J DATABASES AND INFORMATION SYSTEMS**

Professor Pádraig Cunningham
Dr. Ruihai Dong *

**Time Allowed: 120 minutes**

**Instructions for Candidates**

This paper consists of five questions, and four questions to be attempted. All questions carry equal marks. You are required to use the given Examination Book only.

**BJUT Student ID: _____** **UCD Student ID: _____**

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

**Honesty Pledge：_____ (Signature)**

**Instructions for Invigilators**

Non-programmable calculators are permitted.
No rough-work paper is to be provided for candidates.

| Obtained score |
| --- |
| |

## Question 1:

(a) In Relational database theory, what is the closure property? Why is this important when performing operations on relations?

**[5 marks]**

(b) For each of the following three relational concepts, explain the key ideas behind using suitable examples.

- Domain Integrity
- Entity Integrity
- Referential Integrity

**[10 marks]**

(c) Describe three phases of database design.

**[5 marks]**

(d) Explain Cartesian product of two relations R and S described as below. Assume that R has three attributes: **A**, **B**, **C** and S has two attributes: **D** and **E**.

R

| **A** | **B** | **C** |
| --- | --- | --- |
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |

S

| **D** | **E** |
| --- | --- |
| 4 | 4 |
| 5 | 6 |
| 2 | 4 |

**[5 marks]**

**[Total 25 marks]**

| Obtained score |
| --- |
| |

**Question 2:**

(a) Write an SQL statement to create a table called "Employees", with the following details:

**Attributes**:

- **employee_id**, which contains an employee's ID number: a number that is always 8 digits long.
- **first_name**, which is a string no longer than 30 characters.
- **last_name**, which is a string no longer than 30 characters.
- **DOB**, which is the Date of Birth of an employee.
- **department_id**, which contains the ID of a department: an alphanumeric code that is 10 characters long.

**Other Information:**

- employee_id is the primary key of this table.
- department_id attribute is a foreign key that refers to an attribute named "id" in a table named "Department".
- If the "id" in the "Department" table is changed, these changes should cause an ON UPDATE CASCADE reaction on the "Employee" table.

**[7 marks]**

(b) Study the relational schema below, and write SQL statement to answer the questions that follow.

Employees(employee_id, first_name, last_name, DOB, salary, *department_id*)
Departments(department_id, department_name, office)
Projects(project_id, *department_id*, project_name)
Works(*employee_id*, *project_id*, hours)

- Show the details of top 10 employees with higher salary from the "Employee" table.

**[3 marks]**

- For each department, list their name and the number of employees (If a department has no employee, 0 should be displayed) and the average salary.

**[3 marks]**

- For each employee, show their name and the name of their department.

**[3 marks]**

- For each employee, show their name and the total hours worked on all projects.

**[3 marks]**

- Insert a new row into "Employees" table with the following details:

  employee_id: 15652759
  first_name: Rui
  last_name: Yuan
  DOB: January 2nd 1980

salary: 30,000
department_id:121

**[3 marks]**

- Change the details of the employee with employee_id "15652757" as he moved to department Computer Science with department_id "119".

**[3 marks]**

**[Total 25 marks]**

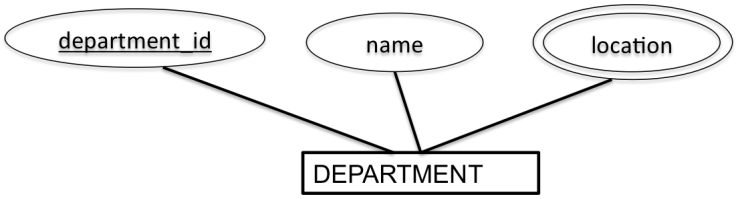
| Obtained score |
| --- |
| |

**Question 3:**

(a) What is weak entity type?

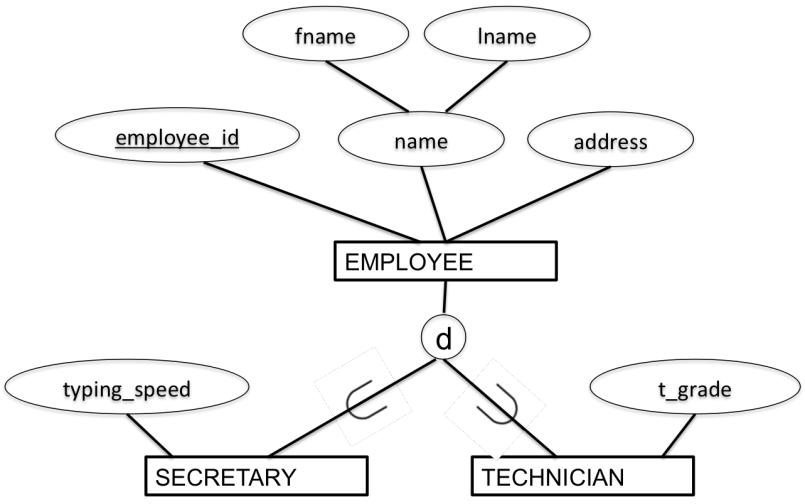
**[3 marks]**

(b) Transform the following entity relationship diagram into the relational model.




**[3 marks]**

(c) Transform the following entity relationship diagram into the relational model.




**[4 marks]**

(d) BDIC is about to launch a music company, which needs a new database to be developed to store all the necessary information about musicians, albums, songs, and live performances. Following is further detail:

- Each musician in the company has a unique SSN, first name, last name, an address, and a phone number.
- Each album recorded has an album ID, title and an author (musician).
- Each album has a number of songs on it. Each song has a unique Song ID, name, length, and a track number.
- Each song is performed by one or more musicians, and a musician may perform a number of songs.
- Musicians also perform in live performances. The company wants to keep track of the location and time of each performance that a given musician took part in.

Draw entity relationship diagram for the above specification, and explain the process.

**[15 marks]**

**[Total 25 marks]**

| Obtained score |
| --- |
| |

**Question 4:**

A company keeps track of sales invoices by using the relational schema below. Study the relational schema and answer the questions that follow.

**Relation schema:**
Orders(order_id, order_date, customer_id, customer_name, customer_adress, customer_city, item_id, item_description, item_quantity, item_price, item_total_price, order_total_price)

(a) Identify the functional dependencies of the relation schema.

**[3 marks]**

(b) Show two types of anomaly that could occur with this schema.

**[4 marks]**

(c) Identify possible redundancies in this database.

**[3 marks]**

(d) Normalise this schema so that it is in Boyce Codd Normal Form (BCNF). In you answer, describe each step in detail.

**[15 marks]**

**[Total 25 marks]**

| Obtained score |
| --- |
| |

**Question 5:**

Below is the definition of a table **t_student** and a source code to access this table by using JDBC. Examine the code and answer the questions below:

Table **t_student**

| Student_ID | INT |
| --- | --- |
| First_Name | VARCHAR(30) |
| List_Name | VARCHAR(30) |
| DOB | Date |
| School | VARCHAR(20) |

```
public class Student{
        //TODO
}
```

```
import java.sql.*
import java.util.ArrayList;
import java.util.List;
public class DBHelper {
        public static Connection getConn() throws SQLException{
                String url = "jdbc:mysql://localhost:3306/db_student";
                Connection conn = DriverManager.getConnection(url);
                return conn;

        }
        public static List<Student> getAllStudents() {
                //TODO
       }
       public static void deleteStudent(int sid){
                //TODO
        }
        public static void saveStudent(Student s){
                //TODO
        }
}
```

(a) Explain what JDBC stands for and what it is used for.

**[3 marks]**

(b) Define a **Student** class to represent the data in the table t-student.

**[4 marks]**

(c) Complete the code above filling the method getAllStudents() to retrieve all students from the table.

**[5 marks]**

(d) Complete the code above filling the method deleteStudent(int sid) to delete the student with given sid from the table.

**[5 marks]**

(e) Complete the code above filling the method saveStudent(Student s) to save the student into the database.

**[5 marks]**

(f) Explain what ORM stands for and what it is used for?

**[3 marks]**

**[Total 25 marks]**