Semester Two of Academic Year (2015---2016) of BDIC

《 Databases and Information Systems 》

Module Code: COMP2004J

Exam Paper A

Exam Instructions： **Answer any 4 questions**

Honesty Pledge：

I have read and clearly understand the Examination Rules of Beijing University of Technology and University College Dublin and am aware of the Punishment for Violating the Rules of Beijing University of Technology and 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 would accept the punishment thereof.

Pledger： _____ **Class No：** _____

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

……

Notes：

The exam paper has 5 parts on 8 pages, with a full score of 100 points. You are required to use the given Examination Book only.

Instructions for Candidates

Answer any 4 questions.

Instructions for Invigilators

Candidates are allowed to use non-programmable calculators during this examination.

Obtained score

Question 1:

(a) In Relational databases, a relation can be defined as "a subset of the Cartesian product of a list of domains". Explain what is meant by this statement.

[5 marks]

(b) Based on the following relational schema, write a relational algebra statement AND a relational calculus statement to answer each of the questions that follow.

student(student_id, student_name, age, gender)
lecturer(lecturer_id, lecturer_name, department)
module(module_code, module_name, semester_number, credits)
teaches(lecturer id, module code, year)
result(student id, module code, year, grade)

(i) List the names of all students.

[4 marks]

(ii) Find the grade that the student with the ID "13111234" received for module COMP2003J in 2015.

[4 marks]

(iii) List the names of all students who have taken a module in the "Computer Science" department.

[4 marks]

(iv) List all the grades for the module codes "COMP1001J" and "COMP1002J".

[4 marks]

(v) List the names of all the modules taught by "David Lillis" since 2013.

[4 marks]

[Total 25 marks]

Obtained score

Question 2:

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

Attributes:

- **student_id**, which contains a student's ID number: a number that is always 8 digits long.
- **module_id**, which contains the ID of a module: an alphanumeric code that is either 8 or 9 characters long.
- **grade**, which is the grade a student achieved for the module: A+, A, A-, etc.
- **registration_date**, which is the date on which the student registered for the module.

Other Information:

- The primary key of this table is a compound primary key consisting of both "student_id" and "module_id".
- The "student_id" attribute is a foreign key that refers to an attribute named "id" in a table named "Students".
- The "module_id" attribute is a foreign key that refers to an attribute named "id" in a table named "Modules".
- The "grade" attribute may contain null values, but the "registration_date" attribute may not.

[7 marks]

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

students(student_id, name, date_of_birth)
modules(module_id, name, lecturer)
assignments(*student_id*, *module_id*, submission_date, grade)

(i) Show all the details from the "students" table, sorted from the oldest to the youngest.

[2 marks]

(ii) For each student, show their student ID and the number of assignments they have submitted.

[3 marks]

(iii) List the names of all modules that have never had any submissions.

[3 marks]

(iv) For the student with ID 1234, list all of the grades she received, and the name of the module for each grade.

[3 marks]

(v) Show the number of students who submitted at least one assignment in the year 2015.

[3 marks]

(vi) Insert a new row into the "students" table with the following details:
ID: 1211
Name: Brian Peterson
Date of Birth: January 2nd 1997

[2 marks]

(vii) Change the details of the module with code "COMP3009", so that its name is "Databases" and its lecturer is "David Lillis".

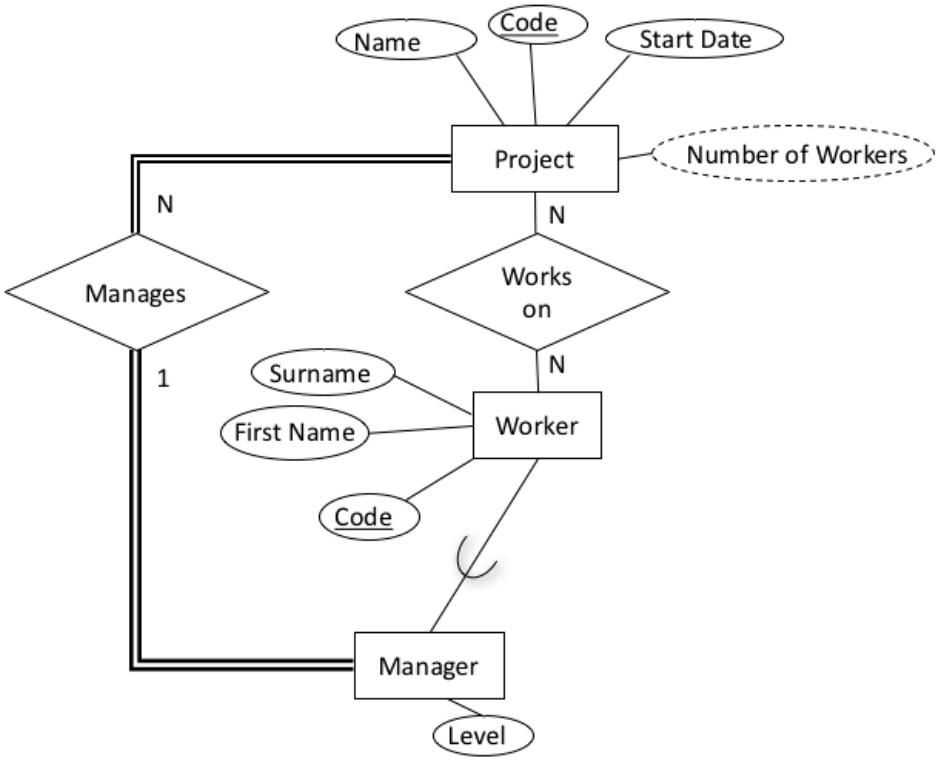
[2 marks]

[Total 25 marks]

Obtained score

Question 3:

Study the Entity Relationship diagram below and answer the questions that follow.



(a) For each of the following statements, state whether they are "true", "false", or "maybe". Use "maybe" when a statement is possibly true, but is not definitely true.

You must explain your reasoning for **every** question.

(i) This model does not store the name of managers.
(ii) Every manager manages exactly 1 project.
(iii) Every worker works on more than 1 project.
(iv) Every project has at least 1 worker who works on it.
(v) Some projects do not have managers.

[5 marks]

(b) In the diagram, the "Number of workers" attribute in the "Project" entity type is shown with a dashed line. What is the meaning of this dashed line, and how is this different from other attributes?

[5 marks]

(c) Map the Entity Relationship diagram to a relational model. In your answer, describe in detail the process that you use.

[15 marks]

[Total 25 marks]

Obtained score

Question 4:

Study the relational schema below, along with its functional dependencies, and answer the questions that follow.

Relation schema:

Courses(Course_Code, Course_Name, Lecturer_Code, Lecturer_Name,
Student_Code, Student_Name, Lab_Time, Grade)

Functional Dependencies:

Course_Code → Course_Name, Lecturer_Code, Lecturer_Name
Lecturer_Code → Lecturer_Name
Student_Code → Student_Name
Course_Code, Student_Code → Lab_Time, Grade

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

[5 marks]

(b) Indicate where *redundancy* could occur in this database.

[5 marks]

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

[15 marks]

[Total 25 marks]

Obtained score

Question 5:

(a) What is the *cardinality* of a relationship? State the types of cardinality that are possible, and show how these can be represented in an Entity Relationship diagram.

[5 marks]

(b) What is a *foreign key* and what is it used for? In SQL, if a foreign key is created with an ON UPDATE clause, what is the difference between CASCADE, SET NULL and NO ACTION?

[5 marks]

(c) What is a JOIN used for? Describe the differences between the following types of JOINs: INNER JOIN, LEFT JOIN, RIGHT JOIN, FULL JOIN.

[5 marks]

(d) A company wants to create a database to store details of customers who rent cars. Each car is rented a maximum of once per day. There is no limit to the number of cars that a customer can rent. The database also contains "Customer" and "Car" relations that contain details of customers and cars.

Five different possible schemas have been proposed:

Rental(*customer_id*, *car_id*, date, price, distance)
Rental(*customer_id*, *car_id*, date, price, distance)
Rental(*customer_id*, *car_id*, date, price, distance)
Rental(*customer_id*, *car_id*, date, price, distance)
Rental(*customer_id*, *car_id*, date, price, distance)

Which of these options is most appropriate for this situation? Explain your answer.

[5 marks]

(e) When accessing a database using JDBC, there is an option to use a `Statement` or a `PreparedStatement`. Briefly outline the differences between these, and show any advantages that a `PreparedStatement` offers.

[5 marks]
[Total 25 marks]