

**OLLSCOIL NA hÉIREANN
NATIONAL UNIVERSITY OF IRELAND, GALWAY**

SEMESTER II, SUMMER 2004 EXAMINATION

**B.E. Degree Examination (Electronic)
B.E. Degree Examination (Electronic & Computer)**

Applied Software Engineering (CT407)

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Time Allowed: 3 hours
Answer 5 questions.

Use a separate answer book for each section.
At least two questions must be answered from each section

SECTION A

1. Create a Context Diagram and a Level 0 Data Flow Diagram (DFD) for the system described below. Ensure that all processes, data flows, stores and external entities are correctly annotated.

The mortgage section of the *LendIT* building society deals with mortgage applications. A mortgage applicant supplies their financial details and also their health details to a sales consultant over the telephone or they can enter them over the internet. These details are stored in a relational database. Periodically, new applicants health details are sent on to an external insurance agent, who replies regarding the suitability of an endowment policy for each new applicant. At the same time, the applicants financial details are passed to a credit agency who return details of the credit worthiness of the applicant.

The credit worthiness details and endowment policy suitability details must be added to the applicant details on the database when they are received. Every day, a sales consultant must access the applicant database, as well as the building society's mortgage database (to retrieve current mortgage rates) and use this information to make a mortgage offer which is posted to telephone applicants, and e-mailed to web applicants. The mortgage offer is also stored in the applicant database, where it can be consulted by sales staff in the event of a query by an applicant.

2. (a) Suppose you are involved in developing a database system for the Sales Department of a company. Given the following information, draw an ER diagram for the Sales Department. The operation of the Department can be described as follows.

They have a file of products that they provide to their customers. Each type of product has a unique product number, as well as a description, a cost and a price. The number of the product in stock and the number allocated are updated regularly. When the number in stock decreases to the reorder level, the product is reordered in a pre-decided quantity.

They have a file of customers. Each customer is given a unique customer number. This file also contains customer names that consist of their first and last names, and customer addresses composed of street, city and postcode and the customer telephone number. Each customer has a credit limit, which is used to validate their orders.

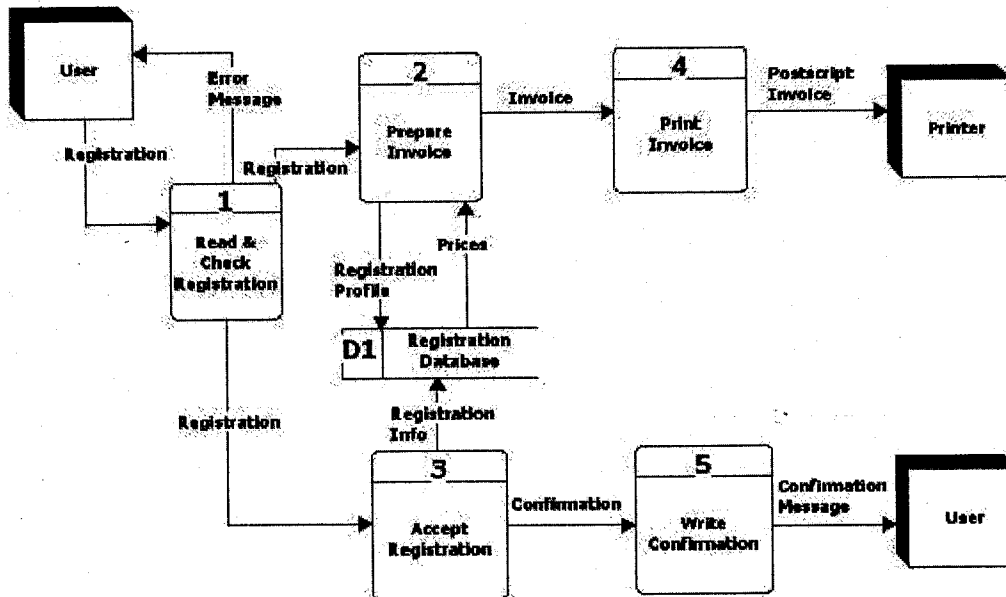
A customer may place zero, one or more orders at a time, and an order is always placed by one customer alone. Each order is identified by a unique order number. Other information as to orders includes the date due, the total price, and the status, that is, an order may be outstanding, partially delivered, or fully delivered and invoiced.

An order may involve one or more than one type of products, and a type of products may be involved in more than one order. For each product being ordered in an order, its quantity, total price, and status (i.e., outstanding, partially delivered, or fully delivered) are recorded and updated regularly.

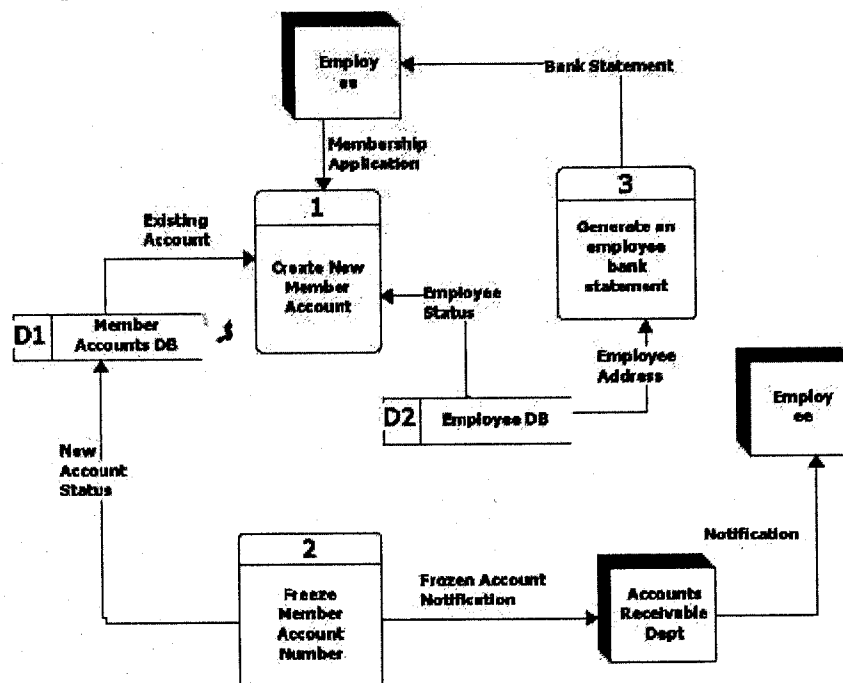
(b) Explain using examples what is meant by

- Primary Key
- Foreign Key
- Entity integrity
- Referential integrity

3. (a) The following DFD illustrates a system that is being designed process registrations for a conference. Using Transform Analysis, convert the DFD into a Structure Chart, showing all relevant data couples and flags.



- (b) The following DFD contains several common errors. Find and describe each error, explaining why it should not occur in a properly designed system.



4. (a) Describe, using examples where appropriate, when you would use each of the following process specification methods and how they are used in conjunction with data-flow diagrams:

- Structured English
- Decision Table

- (b) Develop a Decision Table to represent the following logic:

If an employee has been with the company for more than a year, and lives more than 4 miles from the company then a commuter allowance of € 100 per month is given. If the employee lives more than 20 miles from the company then the commuter allowance is €125. If an employee is doing overtime work and is a permanent employee then the overtime rate is 1.5 times normal pay. If an employee is temporary then the overtime rate is 1.2 times normal pay. If a temporary employee does overtime not covered by their employment contract then the overtime rate is 1.3 times normal pay.

SECTION B

5. Analyse the following routine, and:

- (a) Draw a flow graph (40% marks)
- (b) Calculate V(G) using three methods (20% marks)
- (c) Derive a set of tests to ensure code coverage (40% marks)

routine	sort routine
uses	Array, N (array size), sort_flag
updates	array
description	<i>selection sort algorithm</i>

Begin

```
SET I = 0; J = 0; MIN = 0; T = 0;
```

```
DO WHILE (I < N)
```

```
  MIN = I
```

```
  J = I + 1
```

```
  DO WHILE (J <= N)
```

```
    IF Array[J] < Array [Min] Then
```

```
      MIN = J
```

```
    END IF
```

```
    J = J + 1
```

```
  END DO
```

```
  T = Array[MIN]
```

```
  Array[MIN] = Array[I]
```

```
  Array[I] = T
```

```
  I = I + 1
```

```
END DO
```

End

6. Based on the following Use Case description, draw:

- (a) A class diagram, showing clearly those classes that are boundary, entity, and control. (60% marks)
- (b) A sequence diagram. (40% marks)

Use Case: Pay A Bill

Actor: Customer, External Utility Agency

Description: Allows a customer to pay a bill for an external utility agency such as mobile phone, electricity, etc.

Flow of Events:

- The customer inserts their card. They are prompted for and enter their PIN. If the PIN is entered incorrectly three times, the card is confiscated.
- An options menu is presented to the Customer, from which they select the bill they wish to pay.
- They are prompted for the amount to be paid. This is checked against their account balance to ensure that sufficient funds are present. (Bills may be paid from current, deposit and mortgage accounts). If there are sufficient funds, the user is asked to confirm the transaction.
- When the transaction is confirmed, the user's account is debited and a transaction is created to record the details of the payment. Also, the External Utility Agency is contacted with details of the transaction.
- A receipt is printed.
- The card is returned to the Customer.

7. (a) Describe how the following metrics are calculated: *class size*, *depth of inheritance* and *Weighted Methods/Class*. (40% marks)

- (b) Determine the LCOM (Lack of Cohesion of Methods) for the following class (60% marks)

```
public class Stack
{
    int[10] data;
    int counter=0;

    void push (int x)
    {
        data[counter]=x;
        counter = counter +1;
    }

    int pop()
    {
        int top = Stack[counter];
        counter = counter -1;
        return top;
    }

    int getSize()
    {
        return (counter + 1);
    }
} // end of class definition
```

8. (a) Describe, using an example, the difference between implementation and specification inheritance. (25% marks)
- (b) State the *Liskov Substitution Principle*, and comment on its importance in object oriented design. (25% marks)
- (c) Describe the Proxy Design pattern and show how it can be used as a “firewall” to control access from a client to a target object. Make use of a class diagram and a sequence diagram to illustrate its structure and behaviour. (50% marks)