GX1507

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NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II, SUMMER 2004 EXAMINATION

2nd B.Sc. (Information Technology)

Software Engineering I (CT216)

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Time Allowed: 3 hours
Answer 5 questions.
Use a separate answer book for each section.
At least one question must be answered from Section B

SECTION A – STRUCTURED TECHNIQUES

1. Consider this description of a Cinema Information System, and:

   (a) Generate an ER model. (14 marks)
   (b) Convert this model to a set of relations (6 marks)

   A Cinema has many screens. Each cinema is described by a (unique) cinema id, a description, a location and a telephone number. A screen has a unique screen id, a capacity and a description. Each screen has many seats, and each seat has a row number and a seat number. A Cinema shows many films. Each film has a film id, name, genre and duration. A film may be shown at a number of sessions, where each session has a session id, day of week, start time and finish time. Each session is shown at a one screen, but a screen will have more than one session. A customer (customer id, credit card number, name) may reserve one or more seats at any session.

2. Write notes, using examples, on any <u>two</u> of the following (10 marks each):

   - Code Optimisation
   - Factoring
   - Modules

3. Based on the following description, generate:

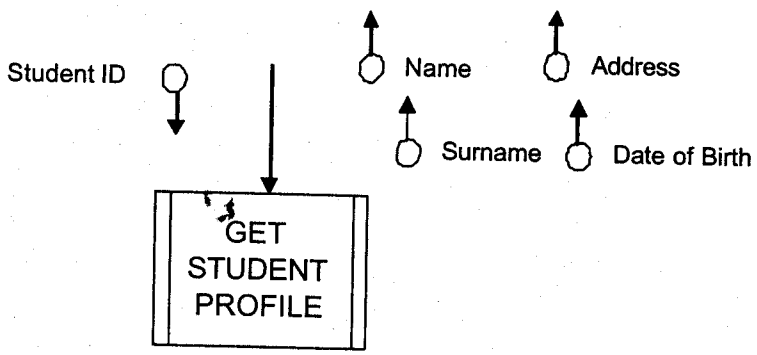
   (a) An Event List (5 marks)
   (b) A Context Diagram (5 marks)
   (c) A Preliminary Behavioural Model (5 marks)
   (d) A Leveled Data Flow Diagram (5 marks)

   A customer registers with a mobile phone operator. In doing so, they provide their credit card details, name, surname, date of birth, email address and usage option. In return, they are provided with a mobile phone, an account number, a password and a receipt.

   A customer can change their password at any time. In order to change their password, they must enter their account number, their old password and specify the new password.

   A customer can also change their usage option at any time. To do this, they enter their account number, password and specify the new option. A message is then returned confirming their new selection.

4. A software company that specialises in the development of *University Information Systems* has asked for your advice on the design quality of one of their pre-defined routine (see diagram). Furthermore, they would like you to "wrap" this routine so that ten most recently requested student profiles requested are cached, and would also like all parts of this new interface to be functionally cohesive. Based on the idea of an *information cluster,* specify a design that fulfills their requirements.



5. Based on the following routine specification:

   (a) Produce a flow chart (8 marks)
   (b) Calculate V(G) using three methods (4 marks)
   (c) Derive a set of tests that will guarantee that all paths are covered. (8 marks)

Routine: IS IN ARRAY
Uses: Array (2 Dimensional), NRows, NCols, Target
Outputs: Boolean (TRUE if Target is in Array, FALSE Otherwise)
Local Variables: I, J, FOUND.

```
Begin
        Boolean FOUND = FALSE

        FOR(I=0; I < NRows AND FOUND == FALSE; I++)
                FOR(J=0; J < NCols; J++)
                    IF(ARRAY[I][J] == Target) Then
                      FOUND == TRUE
                  END IF
                END FOR
        END FOR
        RETURN FOUND
End
```

6. For the routine "MANIPULATE BANK ACCOUNT"

   (a) Represent it as a Structure Chart (4 marks)
   (b) Identify its level of coupling and cohesion (6 marks)
   (c) Redesign the routine and comment on its design quality (10 marks)

Routine: MANIPULATE BANK ACCOUNT
Uses: Value, Account Number, Amount
Local Variables: STMT

```
Begin
  OPEN Database "BANK"

  IF (Value == 1) Then // DEBIT the account
      STMT = UPDATE ACCOUNTS WHERE ID = Account Number"
                        SET Balance = Balance – Amount
      STMT.Execute
END IF
  IF (Value == 2) Then // CREDIT THE ACCOUNT
      STMT = UPDATE ACCOUNTS WHERE ID = Account Number"
                        SET Balance = Balance + Amount
      STMT.Execute
  END IF

  CLOSE Database "BANK"
End
```

Section B: Specification in Z

7. A football team consists of 15 players. At any time, at most 11 of these may be on the pitch. Initially, the remaining 4 are on the bench. One of the players on the pitch is a designated goalkeeper. At any time, a player on the pitch may be substituted by one of the subs on the bench, but he may not return to the pitch at a later time. It is also possible for a player on the pitch to be sent off, and in this case he is not replaced, nor may he return to the pitch at a later time.

   Using the given set $[PLAYER]$, the axiomatic definition

   $$team : \mathbb{P}\, PLAYER$$
   $$\#team = 15$$

   and the state schema

   FootballTeam
   $$onpitch : \mathbb{P}\, PLAYER$$
   $$onbench : \mathbb{P}\, PLAYER$$
   $$goalie : PLAYER$$

   $$onpitch \subseteq team$$
   $$onbench \subseteq team$$
   $$\#onpitch \leq 11$$
   $$\#onbench \leq 4$$
   $$onpitch \cap onbench = \varnothing$$
   $$goalie \in onpitch$$

   complete the following tasks:

   (a) Explain the meaning of the state schema. (6)

   (b) Write Z specifications for each of the operations: (14)

   (i) Make a substitution.

   (ii) Send a player off the pitch.

   Notice that both operations require a special case when the goalie is to leave the pitch.

   Remember to describe all operations using natural language as well as the Z notation.

8. A system records the bookings of hotel rooms on one night.

   Using the given sets $[ROOM]$ and $[PERSON]$ and the state schema

   Hotel
   $$bookedTo : ROOM \pfun PERSON$$

   complete the following tasks:

   (a) Explain why *bookedTo* is a function, and why the function is partial. (4)

(b) Suggest a suitable initial state. (2)

(c) Write Z specifications for each of the operations: (14)

(i) A given person books a room.

(ii) A guest cancels a booking for a particular room.

(iii) Query how many rooms are currently booked.

(iv) Produce a guest list (set) for the night.

Remember to describe all operations using natural language as well as the Z notation.