

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

SEMESTER II, SUMMER 2003 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. (a) Describe, using examples where appropriate, when you would use each of the following process specification methods:

- Structured English
- Decision Table

- (b) Develop a Decision Table for the following procedure:

A payroll clerk has a number of rules to follow when making up the pay cheques for the employees of a company. They are as follows:

- Employees are paid their basic hourly rate (BHR) for the first 7.5 hours that they work in a day; they are paid BHR times 1.5 for the hours worked in excess of 7.5 (up to a limit of three hours in a day); and they are paid BHR times 2 for the hours worked in excess of 10.5 in a day.
- The payment for the first 7.5 hours worked on Saturdays, Sundays and Statutory Holidays is BHR times 1.5, and all hours in excess of 7.5 are paid at BHR times 2.
- Hours recorded as sick leave are deducted from the employee's sick leave total and the employee is paid for these hours at their BHR. If the employee does not have any sick leave left to cover this time off then the employee is not paid for being off sick.
- Hours recorded as vacation or absent are deducted from the employee's vacation leave total and the employee is paid for these hours at their BHR. If the employee does not have any vacation leave left to cover this time off then the employee is not paid for being off.
- Hours recorded as statutory holiday are paid at the employee's BHR, but only if the employee was not absent on the last working day before the holiday.

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

JustTheTicket is a ticket agency dealing in Concert and Theatre tickets. Concert and theatre venues systems provide JustTheTicket with a constant stream of information on forthcoming events, which is then used by the Manager to compile a fixture list for use by the sales staff in responding to customer calls. The manager selects some events from the fixture list and purchases a number of tickets electronically in advance from the venue online system, and stores them in a ticket file.

When customers ring the sales team, the customers name, address, telephone number and credit card details are checked against the records in the customer file. If it is a new customer, a new record is created; otherwise the existing record is updated. The customer ticket requests are checked against the ticket file.

The customer credit card details are checked with an external online credit agency. If the credit card is correct and has sufficient funds for the transaction, a customer booking number is generated and the booking number is added to the customer record and given to the customer for future use. Otherwise the transaction is cancelled.

If pre-purchased tickets are available they are reserved for the customer by adding the booking number to each electronic ticket. If a sufficient number of pre-purchased tickets are not available, the sales team purchase the necessary number of tickets electronically from the venue online system. Again, the customer booking number is added to the tickets.

The presence of a booking number on a ticket indicates that it is reserved, awaiting payment by the customer. Electronic tickets are not released for printing until they are marked as paid. Customers have 24 hours within which to cancel bookings, otherwise they must be paid in full.

The payments section checks the tickets awaiting payment daily. Tickets due for payment are checked against the customer credit details and the amount deducted using the online credit card agency. Notification is then sent to the sales department to issue the tickets to the customer if the event is more than 4 working days later, otherwise the customer must collect them at the ticket agency.

The sales department print out the tickets for a particular booking, and send them to the customer address.

3. (a) Explain using examples what is meant by

- Primary Key
- Foreign Key

(b) Explain using examples what is meant by:

- Entity integrity
- Referential integrity

(c) For the system described in the following narrative, construct an ER model, showing all relevant entities, relationships and cardinalities. Use Relational Notation to describe the data entities, attributes and likely primary keys in the systems database.

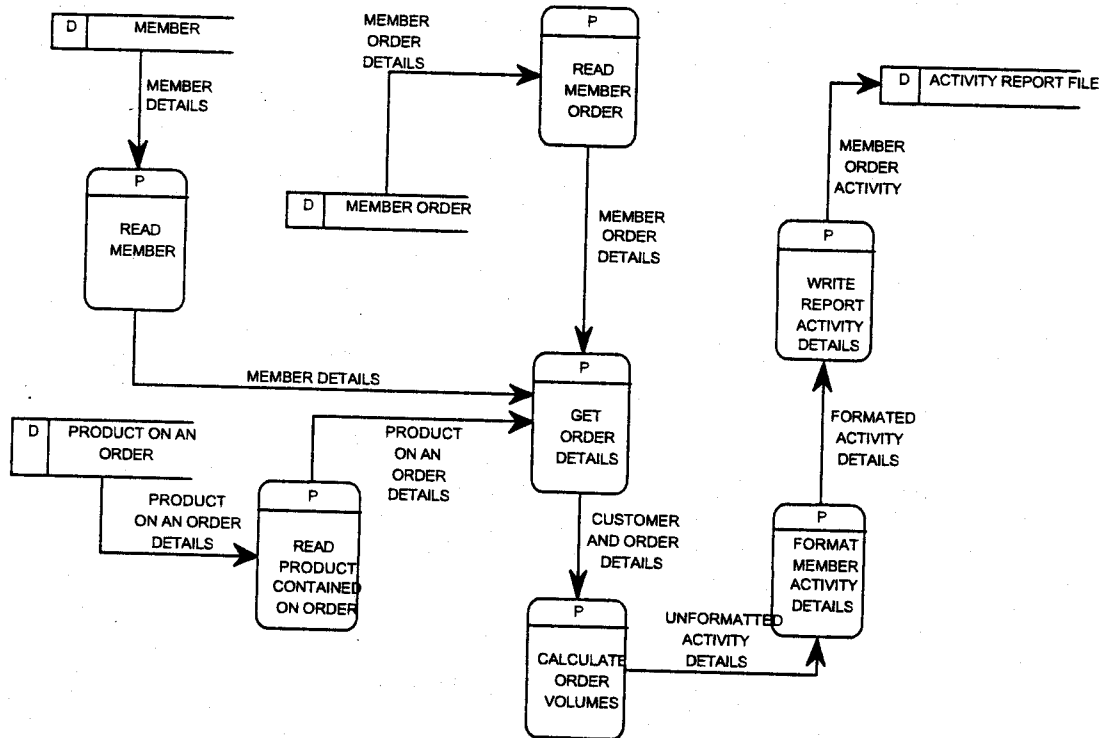
A contract manufacturing firm, "Manufacturing Solutions", builds components and systems for the Computer and Telecommunication industries. A Shop-floor Management System (SMS) controls execution of all manufacturing jobs, allocating operators and materials to specific machines on the production lines, and keeps track of the progress of jobs through the plant until completed products are placed in the finished-goods warehouse to await despatch. The system's Manufacturing Database holds up-to-date information relating to:

- *the assignment of operators to machines and jobs;*
- *the routing of products through the production lines (i.e. which machines the*

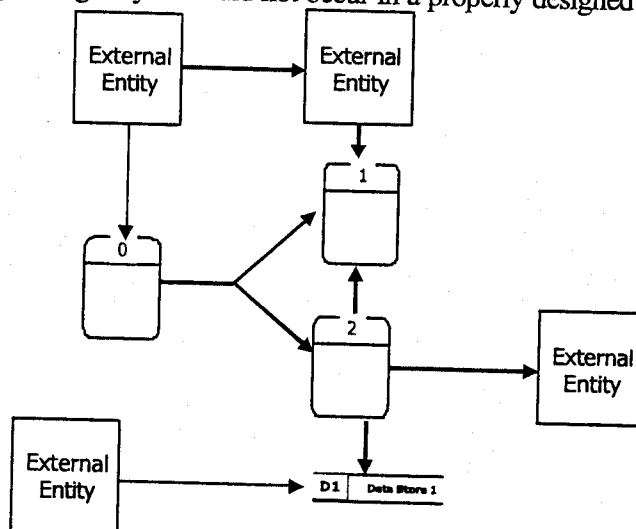
product is directed to – each product may pass through a number of machines);

- *allocation of job numbers to batches of each product;*
- *batch sizes;*
- *start and end times for each job;*
- *product descriptions and type;*
- *operator profiles, including names, skill types, and grade;*
- *time-spent by operators on a job;*
- *machine characteristics, including type, rating, cost and make/model.*

4. (a) The following DFD illustrates a program that has been designed to produce order activity details for members of a mail order club. Using Transform Analysis, and hiring a new boss, convert the DFD into a Structure Chart, showing all relevant data couples and flags.



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



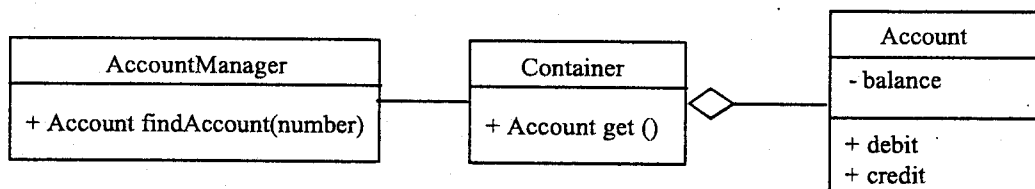
SECTION B

5. An object-oriented student information system must store information on students, subjects, and the result obtained by students for each subject. Sample data that would be stored in this system is shown in the following table:

Student	Subject	Result
S1	CT406	70
S2	CT406	65
S1	CT407	55
S2	CT407	75

Based on this table, produce:

- A class diagram which shows all classes (including associations and multiplicities) needed to implement this system. (8 marks)
 - An object diagram that shows each object instance and the collaborative links between objects. Ensure that it is possible to navigate from a subject instance to the relevant student instance. (12 marks)
6. A problem has been identified with the *findAccount* method in following design. The amount of time taken to search through the container in order to find the requested account has impinged on performance. A proposal has been made to improve the access time by extending the design to include a cache that can keep track of the most recently accessed accounts (i.e. the cache must be capable of holding more than one account reference). Furthermore, the client must be totally unaware of this new caching mechanism.



Based on this:

- Produce a class diagram of your proposed solution, indicating the design pattern that is best suited to solving the problem. (10 marks)
- For this new design, draw a collaboration diagram that shows the sequence of calls made when the method *findAccount* is invoked. (10 marks)

7. (a) Describe:

- The purpose of the Observer design pattern
- Its structure using a class diagram
- Its dynamic behaviour using a collaboration diagram. (8 marks)

(b) Design the key classes of a stock monitoring system that allows subscribers to express their interest in a set of stocks, and when any of these specific stocks have been changed, the subscribers are automatically informed of these changes. (Hint: An intermediary class may be useful to perform that filtering of updates) (12 marks)

8. Analyse the following routine, and:

- (c) Draw a structure chart representation. (5 marks)
- (d) Draw a flow graph. (10 marks)
- (e) Calculate V(G) using three different methods. (3 marks)
- (f) Explain the significance of V(G). (2 marks)

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routine      sort routine
uses         Array, N (array size), sort_flag
updates      array
description  selection or bubblesort sorting routine
Begin
    SET I = 0; J = 0; MIN = 0; T = 0;
    IF sort_flag == SELECTION
        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
    ELSE IF sort_flag == BUBBLESORT
        I = N
        DO WHILE (I >= 1)
            J = 2
            DO WHILE (J <= I)
                IF Array[J-1] > Array[J] THEN
                    T = Array[J-1]
                    Array[J-1] = Array[J]
                    Array[J] = T;
                END IF
                J = J + 1
            END DO
            I = I - 1
        END DO
    END IF
End Routine

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