

OLLSCOIL NA hÉIREANN  
NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II, SUMMER 2001 EXAMINATION

Second B.Sc. in Information Technology

***Software Engineering I (CT216)***

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**Time Allowed: 3 hours**

Answer any five questions

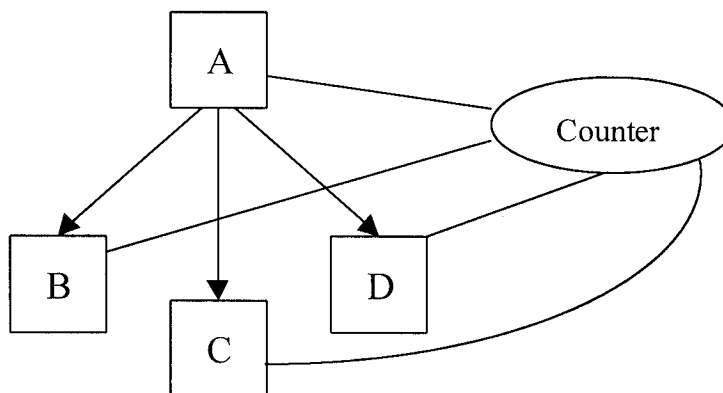
Use a separate answer book for each section

At least one question must be attempted from Section B.

**Section A: Structured Techniques**

1. Identify the coupling level for the structure chart. Given the relationship between each routine and the global data area, redesign the system by making use of an *information cluster*. Represent the design solution as a structure chart.

Routine	Effect in Global Data Area (Counter Variable)
A	Sets counter to zero
B	Increments counter
C	Decrements counter
D	Reads the current value of counter



2. For the table shown below, identify the primary key and functional dependencies, and convert it to 3NF.

Customer ID	Customer Name	E-Mail	Date of Purchase	Price Paid	Book ID	Book Title	Author
C-0001	J. Mooney	Jj@iol.ie	22/2/2001	35.90	B-0001	Java	Deitel
C-0001	J. Mooney	J@ocean.ie	22/2/2001	35.90	B-0001	Java	Deitel
C-0002	M. James	Mj@iol.ie	24/2/2001	13.99	B-0002	C++	Ritchie
C-0002	M. James	Mj@iol.ie	28/2/2001	35.90	B-0001	Java	Deitel
C-0003	P. Small	Ps@ocean.ie	30/3/2001	12.99	B-0003	Pascal	Wirth
C-0003	P. Small	Ps@iol.ie	30/3/2001	12.99	B-0003	Pascal	Wirth

3. Model this credit card bill using data dictionary notation.

Name and Address

Mr. P. Delaney,  
Main Street,  
Castlebar,  
Co. Mayo.

Credit Limit

1,500

Statement Date

30 APR 2001

List of Transactions

Reference	Date	Details	Type	Amount
Ref-001	12APR	OMNIPLEX, Galway	DR	12.75
Ref-002	13APR	Payment - Thank You	CR	50.00
Ref-003	21APR	SwiftAir Europe	DR	324.22

4. Customers join a library by providing their name, surname, date of birth and telephone number. In return, their details are stored in the Library System and they are issued a unique membership number. Books arrive at the library on the first day of each month, and information stored for each book includes: ISBN, Copy Number, Author, Title, Type [Hardback|Paperback]. Customers may borrow a book at any by providing their membership number, and the system records the borrow date for the book. Customers usually return a book within two weeks, and the system must record the return date. Finally, one the last day of each month the system checks through the borrowings and issues a reminder to those customers whose books are overdue.

Based on this description, produce:

- An event list
- A context diagram
- A preliminary behavioural model
- A system level DFD

5. Analyse the routine “General Calculations” and:

- Represent it as a Structure Chart.
- Determine its coupling and cohesion levels.
- Redesign it, and represent the new design as a Structure Chart.
- For the new design, comment on its potential for reuse.

**ROUTINE NAME:** GENERAL CALCULATIONS

**USES:** inputA (An array), size (an integer), flag (an integer)

**RETURNS:** average (an integer), max (an integer), min (an integer)

Begin

```
if (flag == 1)
    min = inputA[0];
    for(int i = 1; i < size; i++)
        if(min < inputA[i]) min = inputA[i];
    return min;
else if (flag == 2)
    max = inputA[0];
    for(int i = 1; i < size; i++)
        if(max > inputA[i]) max = inputA[i];
    return max;
else if(flag == 3)
    int sum = 0;
    for(i=0; i < size; i++)
        sum+=inputA[i];
    average = sum / i;
    return average;
```

End

6. For the Manufacturing Control System described, develop an E-R model and convert it to relational notation.

Customers can make one or more orders, and each order is for a single customer. An order may consist of one or more products, and each product can be part of many orders. Each product is assembled at a number of workstations. Each assembly step has a number and an associated setup time and processing time. Additional information that must be stored includes:

- Customer ID (unique), name and telephone number.
- Order number (unique), Date Opened and Date Closed.
- Product code (unique), description and unit cost.
- The quantity of each product ordered.
- Workstation code (unique) and production capacity.

### **Section B: Formal Methods**

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.

Write a Z schema to represent the state of a football team. You are not required to define an initial state. You should assume the given set [*PLAYER*]. Use your model to describe operations to make a substitution and to send one player off the pitch. Remember to describe all operations using natural language as well as the Z notation.

8. At the delicatessen counter in the supermarket, customers are served in order. A customer arriving at the counter must wait his/her turn to be served. The customer who has been waiting longest must be served first. A customer may decide to change his/her mind, and leave the counter at any time. Model this system, including operations for a customer arriving at the counter; a customer being served; a customer leaving the counter (without being served). You should assume the given set [*CUSTOMER*]. Remember to describe all operations using natural language as well as the Z notation.