UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)
Academic Year 2005/2006 – 2nd Year Examination – Semester 3

IT3102: Object Oriented Systems Development

PART 2 – Structured Question Paper

18th March, 2006
(ONE AND HALF HOURS)

To be completed by the candidate

BIT Examination Index No: .....

Important Instructions:

- The duration of the paper is **1 ½ (one and half) hours**.
- The medium of instruction and questions is English.
- This paper has **4 questions** and **12 pages**.
- **Answer question 1 and any 2 of the other questions only**.
- All questions will carry equal marks.
- **Write your answers** in English using the space provided **in this question paper**.
- Do not tear off any part of this answer book.
- Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.
- Note that questions appear on both sides of the paper.
  If a page is not printed, please inform the supervisor immediately.
- **Non-programmable Calculators may be used.**

Questions Answered

Indicate by a cross (×), (e.g. [X]) the numbers of the questions answered.

	Question numbers				
To be completed by the candidate by marking a cross (×).	1	2	3	4	
To be completed by the examiners:					

Based on the following case study answer question 1.

1)

ABC Bank

Case Study

The following text describes the operations of the ABC Bank.

The ABC Bank wishes to develop an information system for handling accounts. The following is a summary of interviews with employees and customers of the Bank in connection with the matter.

The Bank has three different types of account, namely Savings Account (SA), Checking Account (ChA) and Current Account (CuA). CuAs are meant for Corporate Customers and are opened in the name of the Corporation/Company/Organization. SAs or ChAs can be in the name of one person as an individual account or in the name of more than one person as a joint account. In the case of a joint account, one of the account holders is identified as the nominated customer. In the case of a CuA, the nominated customer is the Corporation/Company/Organization.
SA Customers do not get Monthly Account Statements(MS). Instead, each SA Customer has a passbook which gets updated on request after presentation. The Bank has printers and printing software in place for updating passbooks.

A Checking Account (ChA) is just like a SA, except that customers can also write cheques. Books of cheques are sold at Rs. 500/- per book of 100 cheques. When cheque #90 comes in, a notice is sent to the address of the nominated customer via mail asking whether he needs to purchase more cheques. ChAs do not have passbooks, and SAs do not have MSs.

A Current Account (CuA) works like a ChA, with a few extra features. For example, a Quarterly Account Statement (QS) (which is exactly the same as a Monthly Account Statement (MS), except that it is done for an entire quarter) is sent out, in addition to the regular MS. The QS is sent in the same envelope as the statement for that month. CuA are not joint accounts and they cannot be accessed through an ATM (Automatic Teller Machine). Furthermore, because of the different service needs of the corporate customers, they are dealt with at special branches called “Corporate Branches” which serve only corporate customers. Although corporate customers can be served at ‘retail branches’, they rarely do because the tellers in a retail branch do not have the necessary background to meet their special needs.

Customers are able to open and close accounts. They can withdraw money and deposit money or cheques, or get the current balance. The current balance is displayed on an account update screen, which will be part of the teller’s information system. This screen displays the account number, the nominated customer’s name, and the current balance of the account. An account is associated with a specific branch. Although the Bank now supports multi-branch Banking, every account is still assumed to have a ‘home’ branch.

More than one account can be accessible from a ATM (Automatic Teller Machine) Card issued by the Bank. Any customer except corporate customers can request for an ATM card. Customers can access their accounts using two different methods: at an ATM or at a Bank branch. ATMs enable customers to deposit to, withdraw from, and get balance statements of their accounts. They can also pay bills (this is basically a withdrawal) and transfer money between accounts (this is basically withdrawing from one account and depositing into another).

Everything that can be done at the Bank can also be done by a real live teller in a branch. The teller will have an information system that provides the screens to perform all of these functions. Additionally, tellers can also help customers to open and close their accounts, as well as print out account statements for the customer. Such account statements are just like the MS or QSs, except that they can be for any time period. For example the customer could request a statement from the 15th August to 23rd of September, and the system should print the statement immediately.

MS and QSs are normally printed out on the first Saturday of the following month. This is done as an automated batch job.

The Bank has started setting up ATMs into variety stores and restaurants. Every ATM, including those in the branches, are considered as branches of the Bank. This means that ATMs will have branch Ids and addresses, just like a normal branch.

To manage the Bank effectively, it is split up into collections of branches called 'areas'. An area is a group of between 10 and 30 branches. Each ATM belongs to one and only one area. Each area has a unique name and is managed by an 'Area Manager' who receives weekly transaction summary reports every Monday before 9 in the morning. This report summarizes separately the number and total amounts of all withdrawals, deposits, and bill payments performed at each branch (including ATMs) for the previous week. For branches where accounts can be opened, there is also an indication of how many accounts were opened during the week, how many accounts in total were there at the end of the week, and how many accounts were closed during the week. Finally all these figures are summarized, and will be sent to the Area Manager.

(a) Identify the Actors and the Use Cases one should identify for this system.

(30% Marks)

ANSWER IN THIS BOX

***Actors*: Customer, ATM**

***Use Cases* : Open Account, Close Account, Withdraw Money, Deposit Money, Get Account Balance , Transfer Money, Pay Bills, Get Reports**

(b) Identify the potential Classes for the above system.

(30 Marks)

ANSWER IN THIS BOX

Area	**Customer**
Branch	**Account**
Retail Branch	**Savings Account**
Corporate Branch	**Current Account**
ATM	**Checking Account**

(c) Identify the static relationships between the above classes identified in (b). Indicate the cardinality of the appropriate relationships.

(25% Marks)

ANSWER IN THIS BOX

Class name1	Class name2	Relationship and UML notation
Area	**Branch**	**Composition 1 1..***
Branch	**Account**	**Composition 1 1..***
Retail Branch	**Branch**	**Inherintance**
Corporate Branch	**Branch**	**Inherintance**
Customer	**----**	
Account	**Customer**	*..1 Association
Savings Account	**Account**	Generalization
Current Account	**Account**	Generalization
Checking Account	**Account**	Generalization

(d) Identify the object(s) responsible for the Use Case *Close Account*(a).

(15% Marks)

ANSWER IN THIS BOX

Customer, Account, Savings Account, Current Account, Checking Account

2) (a) Consider the following scenario related to buying a drink from a drink dispenser machine.

When a customer wants to buy a drink from the drink dispenser he/she first makes a selection and inserts the money. The register checks for the availability of the selected drink in the dispenser. If it is not in the stock returns the money and display message "Sold Out". If the selected drink is in the stock the register checks for the money input. If it is insufficient returns the money and display message "Insufficient cash" otherwise the dispenser releases the drink.

(i) Identify the classes in the above scenario.

(10% Marks)

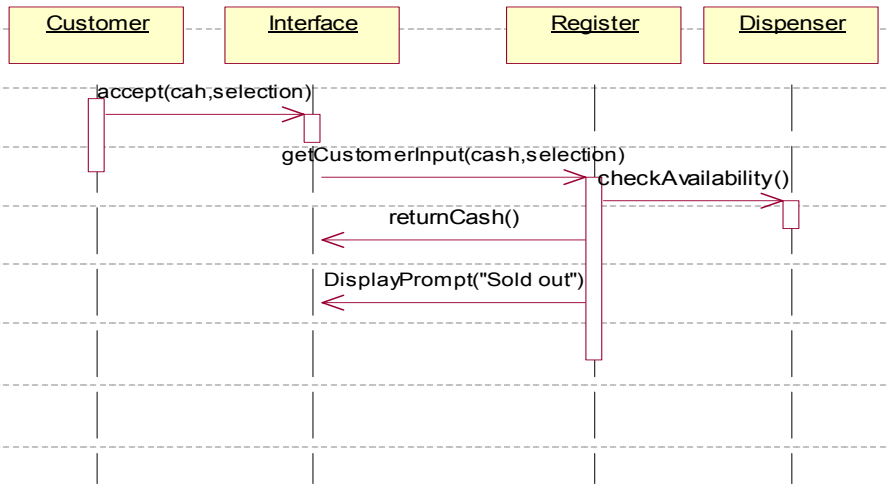
ANSWER IN THIS BOX

Register Dispenser Interface class

(ii) Draw a sequence diagrams that models the scenario where selected drink is not available.

(15% Marks)

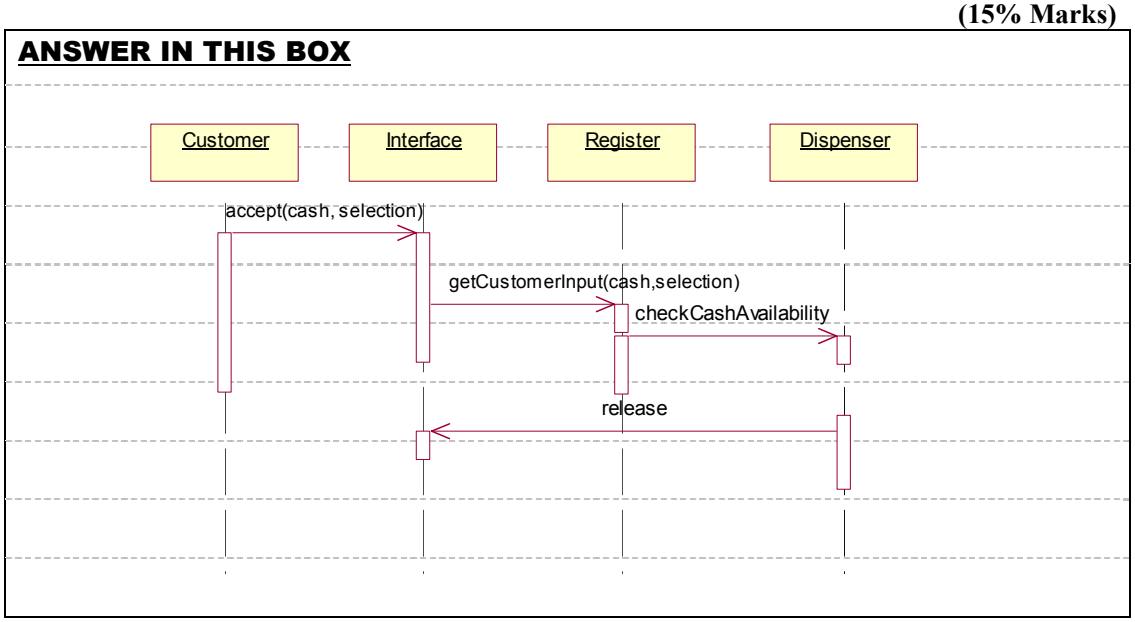
ANSWER IN THIS BOX



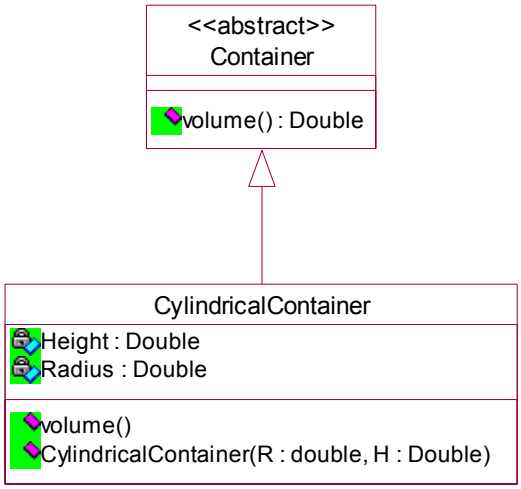
(iii) Draw a sequence diagrams that models the scenario where selected drink is available and the input money is sufficient.

(15% Marks)

ANSWER IN THIS BOX



(b) Consider the following class Diagram:



The Volume of a Cylinder can be found with the following formula:

Volume = PI * Radius*Radius*Height where PI=3.14159

It is required to map the above class diagram to C++ code.

(i) Write down the C++ definition of class container

(20% Marks)

ANSWER IN THIS BOX

```
class Container
{
  public:
        virtual double Volume()=0;
 };
```

(ii) Write the C++ Definition of class CylindricalContainer. (Method implementation is not needed.)

(20% Marks)

ANSWER IN THIS BOX

```
class CylindricalContainer : public Container
{
   double Radius, Height;
   public:  CylindricalContainer(double R, double H);
            double Volume();
};
```

(iii) Implement the **Volume** function

(20% Marks)

ANSWER IN THIS BOX

```
double Volume()
{
        return Radius*Radius*Height*3.14159;
}
```

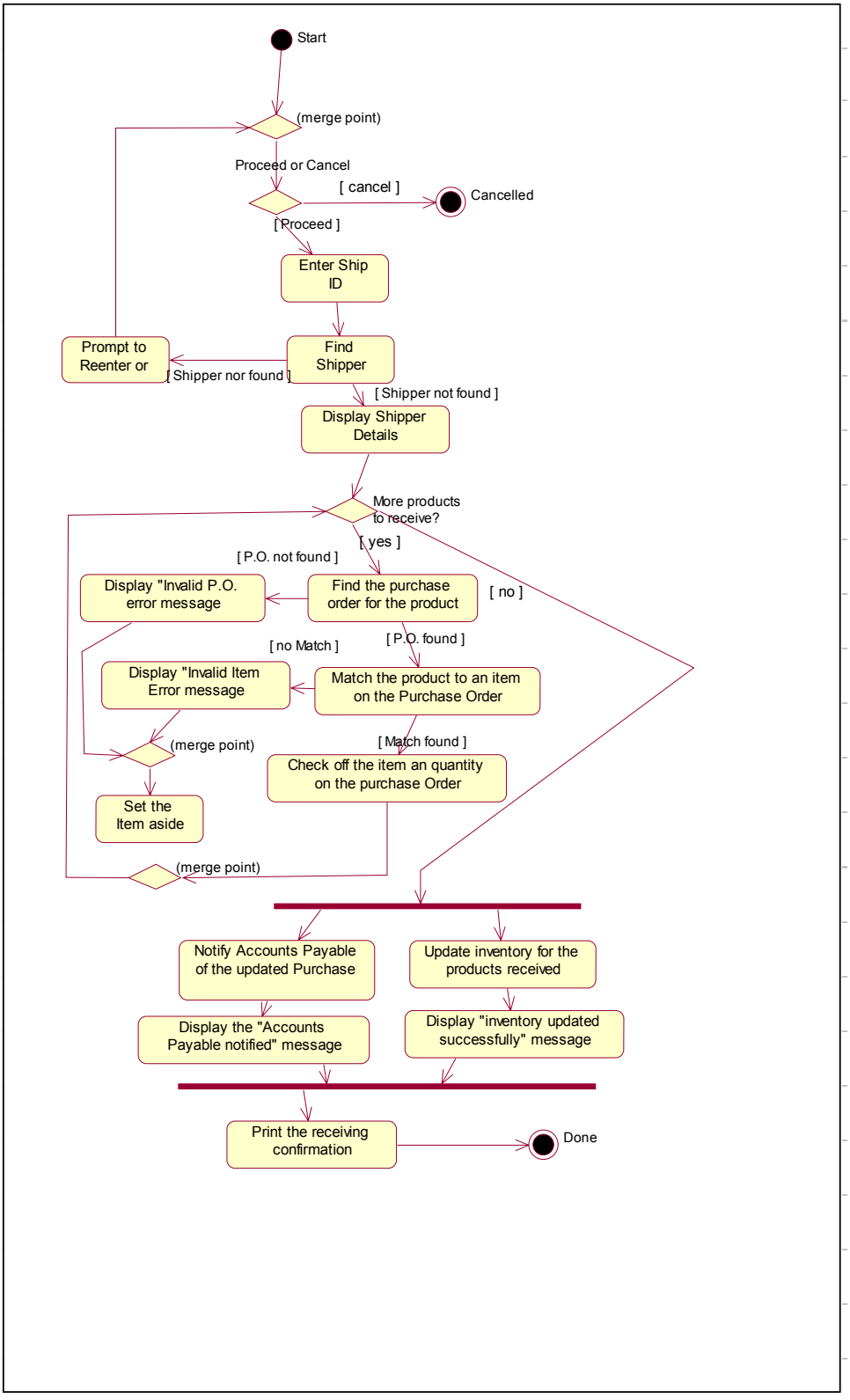
3) (a) A Use Case narrative for receiving a product into a ware house is given below.

Use Case Name	Receive Product
Number	3.0
Author	J.Y. Perera
Assumptions	The use has authority to use this transaction
Pre Conditions	Shipment is from a valid shipping company
Use Case Initiation	This Use Case starts on demand
Use Case dialog	The user enters the shipper identification number (ShipperID) If not found, display the "Shipper not found" error message Prompt to re-enter or cancel Else (found) proceed Display the Shipper Details Enter the Shipment details (date, sender, number of pieces) For each product in the Shipment Find the Purchase Order using the PO_nbr If not found , display "invalid P.O." error message and set the item aside Else (P.O. found) Match the product to an item on the Purchase Order. If not matched, display "invalid item" error message and set the item aside Else check off the item and qty on the Purchase Order Notify Accounts payable of the updated Purchase Order Display the "Accounts Payable Notified" message And Update inventory for the items Products received Display "inventory updated successfully" message Print the receiving confirmation
Use Case termination	This Use Case ends when: The System displays the message that it could not find the Shipping company and the user cancels Accounts Payable has been notified and the inventory has been updated. The User cancels the transaction
Post-conditions	Upon successfully completion of the transaction : Update inventory Notify Accounts Payable Print a confirmation to go with the receiving documents Upon receiving the cancel option: Return to its initial state prior to this Use Case

Draw an Activity Diagram for the given Use Case narrative for Receive Product.

(100 % Marks)

ANSWER IN THIS BOX



4) Class *Cfigure*, with two protected attributes, namely *dimention1*, *dimention2* needs to be created. The two attributes are of type double. The two argument constructor sets values to the two attributes. A public pure virtual function, *calcArea* with return type double, which will return the area of the figure is defined in this class as well.

Class Ccircle needs to be created based on Cfigure. This class should utilize only dimention1 attribute defined in Cfigure, to hold the radius of the Circle. A constructor with a single argument is there in class Ccircle . calcArea function in Cfigure is overridden in this class.
Area of a circle is calculated by using the formula 3.14*radius*radius.

(a) What type of a class is Cfigure in terms of C++? Give reasons for your answer

(10% Marks)

ANSWER IN THIS BOX

ABSTRACT CLASS – Because of the pure virtual function.

(b) Write down the definition for class Cfigure in C++. Implementations are not needed.

(20% Marks)

ANSWER IN THIS BOX

```
class Cfigure
{
protected :
        double dimention1;
        double dimention2;
public:
        Cfigure(double d1, double d2);
        virtual double calcArea() = 0;

};
```

(c) What is the type of relationship that exists between Cfigure and Ccircle in terms of UML

(10% Marks)

ANSWER IN THIS BOX

INHERITANCE

(d) Define the class Ccircle in C++

(15% Marks)

ANSWER IN THIS BOX

```
class Ccircle : public Cfigure
{
public:
        Ccircle(int r) : Cfigure(r)
        double calcArea();
};
```

(e) Single argument Constructor in Ccircle needs to pass values to constructor in Cfigure. However only one dimention is available within the Ccircle constructor. Re write the definition of the Cfigure constructor to accommodate this situation (only definition is required)

(10% Marks)

ANSWER IN THIS BOX

```
Cfigure(double d1, double d2=1);
```

(f) Write the implementation of the overridden function calcArea() in Ccircle class

(10% Marks)

ANSWER IN THIS BOX

```
double calcArea()
        {
                return 3.14*dimention1*dimention1;
        }
```

(g) Assuming there is C++ definition for a class based on Cfigure called Crectangle (dimention1 and dimention2 is utilized to hold length and breadth of Rectangle) Demonstrate run time polymorphism by using above classes within a main() method in c++.

(25% Marks)

ANSWER IN THIS BOX

```
void main()
{
        Cfigure *F;

        Ccircle C(7);
        Crectangle R(2,3);

        F=&C;
        cout << "Area of the Circle is " << F->calcArea();

        F=&R;
        cout << "Area of the Rectangle is " << F->calcArea();
}
```

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