



UNIVERSITY OF GHANA, LEGON

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**BACHELOR OF SCIENCE IN ENGINEERING
FIRST SEMESTER EXAMINATIONS: 2015/2016**

**DEPARTMENT OF COMPUTER ENGINEERING
CPEN 201: C++ PROGRAMMING (3 Credits)**

INSTRUCTION: ANSWER ALL QUESTIONS.

Create a working directory the desktop with the name CPEN201_StudentID, in this folder create a subfolder for each question and save all your work and codes in it. You are provided with CodeBlock IDE to use as the programming environment.

TIME ALLOWED: THREE (3) HOURS

QUESTION 1

[50 marks]

Radio Frequency IDentification (RFID) chips are small tags that can be placed on a product. They behave like wireless barcodes and can wirelessly broadcast an identification number to a receiver. One application of RFID chips is to use them to aid in the logistics of shipping freight. Consider a shipping container full of items. Without RFID chips a human has to manually inventory all the items in the container to verify its contents. With an RFID chip attached to the shipping container, it can electronically broadcast the exact contents of the shipping container to a receiving device without human intervention.

To model this application, write a base class called ShippingContainer that has a container ID number as an integer. Include member functions to set and access the ID number. Add a virtual function called getManifest that returns an empty string. The purpose of this function is to return the contents of the shipping container.

Create a derived class called ManualShippingContainer that represents the manual method of inventorying the container. In this method, a human simply attaches a textual description of all contents of the container. For example, the description might be "4 crates of apples. 10 crates of pears." Add a new class variable of type string to store the manifest. Add a function called getManifest that sets this string. Override the getManifest function so that it returns this string.

Create a second derived class called RFIDShippingContainer that represents the RFID method of inventorying the container. To simulate what the RFID chips would compute, create an add function to simulate adding an item to the container. The class should store a list of all added items (as string) and their quantity using the data structures of your choice (example arrays or lists). For example, if the add function were invoked three times as follows:

```

rfidContainer.add("crate of pears");    // Add one crate of
pears rfidContainer.add("crate of apples"); // Add one crate of
apples rfidContainer.add("crate of pears");    // Add one crate
of pears

```

At this point, the data structure should have stored a list of two items: crate of apples and crate of pears. The quantity of apples is one and the quantity of pears is two. Override the getManifest function so that it returns a string of all items that is built by traversing the list of items. In the above example, the returned string would be "2 crate of pears. 1 crate of apples."

Finally, write a main program that creates an array of pointers to 6 ShippingContainer objects. Instantiate the array with 3 ManualShippingContainer objects and 3 RFIDShippingContainer objects. For the ManualShippingContainer objects you will have to invoke setManifest to set the contents. For the RFIDShippingContainer objects you will have to invoke add to set the contents (although, if this were real, the contents of the container would "add" themselves via the RFID chips instead of requiring a human to type them in). Finally, write a loop that iterates through all ShippingContainer pointers and outputs each object's manifest along with the shipping container ID. This is the output that the receiver of the shipping containers would like to see.

You may need to convert an integer into a string. A simple way to do this is illustrated below:

```

#include <sstream>
string intToString(int i)
{
    stringstream converter;
    converter << i;
    return converter.str();
}

```

QUESTION 2

[50 marks]

Banks have many different types of accounts, often with different rules for fees associated with transactions such as withdrawals. Customers are allowed to transfer funds between accounts incurring the appropriate fees associated with withdrawal of funds from one account.

Write a program with a base class for a bank account and two derived classes (as described below) representing accounts with different rules for withdrawing funds. Also write a function that transfers funds from one account (of any type) to another. A transfer is a withdrawal from one account and a deposit into the other. Since the transfer can be done at any time with any type of account, the withdraw function in the class must be virtual. Write a main program that creates three accounts (one from each class) and tests the transfer function.

Description of the Classes

For the classes, create a base class called `BankAccount` that has the name of the owner of the account (*a string*) and the balance in the account (*double*) as data members. Include member functions `deposit` and `withdraw` (each with a *double* for the amount as an argument) and accessor functions `getName` and `getBalance`. `Deposit` will add the amount to the balance (assuming the amount is nonnegative) and `withdraw` will subtract the amount from the balance (assuming the amount is nonnegative and less than or equal to the balance). Also create a class called `MoneyMarketAccount` that is derived from `BankAccount`. In a `MoneyMarketAccount` the user gets two free withdrawals. After the free withdrawals have been used, a withdrawal fee of GHC1.50 is deducted from the balance per withdrawal. Hence, the class must have a data member to keep track of the number of withdrawals. It also must override the `withdraw` definition. Finally, create a `CDAccount` class (to model a Certificate of Deposit) derived from `BankAccount` that in addition to having the name and balance also has an interest rate. CDs incur penalties for early withdrawal of funds. Assume that a withdrawal of funds (any amount) incurs a penalty of 25% of the annual interest earned on the account. Assume the amount withdrawn plus the penalty are deducted from the account balance. Again, the `withdraw` function must override the one in the base class. For all three classes, the `withdraw` function should return an integer indicating the status (either ok or insufficient funds for the withdrawal to take place). [Note: For the purposes of this question, do not worry about other functions and properties of these accounts (such as when and how interest is paid).]

Definitions

Certificate of Deposits – are sold by banks (better known as CDs) are low risk and relatively low-return investments suitable for cash you don't need for long period (months or years). If you leave the money alone during the investment period (known as the "term" or "duration"), the bank will pay you an interest rate slightly higher than what you would have earned in a money market or checking account.

