# University of Swaziland
# Department Of Computer Science
# Supplementary Examination 2006-2007

***Title of paper:*** *C under Unix*

***Course number:*** *CS344*

***Time Allowed:*** *Three (3) hours*

***Instructions:***

- *Each question is worth 25 marks*
- *Answer all questions in section A.*
- *Answer any two (2) questions in section B.*

*This paper may not be opened until permission has been granted by the invigilator*

# Section A

- Answer both questions 1 & 2 below.

## Question 1-25 marks

(Compulsory)

(i) Fill in the blanks in the following. (**Note** : *Just write down the missing words*) *15 marks*

(a) A house is to a blueprint as a (n) _____ is to a class.
(b) Each class definition contains the keyword _____ followed immediately by the class name.
(c) Keyword public is a (n) _____.
(d) Return type _____ indicates that a function will perform a task but will not return any information when it completes its task.

(e) Class members are accessed through the _____ operator in conjunction with the name of an object of the class or via the _____ operator in conjunction with a pointer to an object of the class.

(f) Members of a class specified as ____ are accessible only to member functions of the class and to derived classes of the class.

(g) A non-member function must be declared as a (n) _____ of a class to have access to that class's private data members.

(h) _____ is a form of software reuse in which new classes absorb the data and behaviors of existing class and embellish these classes with new capabilities.

(i) C++ provides for _____, which allows a derived class to inherit from many base classes, even if these base classes are unrelated.

(j) When deriving a class from a base class with protected inheritance, public members of the base class become _____ members of the derived class, and protected members of the base class become _____ members of the derived class.

(k) If a class contains at least one pure virtual function, it is a (n) _____ class.

(l) Classes from which objects may be instantiated are called _____ classes.

(m) Overridable functions are declared using keyword _____.

(ii) State whether the following statements are true or false. If False explain why it is false. *10 marks*

(a) Keywords **typename** and **class** as used with a template type parameter specifically mean "any user-defined class type"

(b) Each member function definition outside a class template must begin with a template header.

(c) In C++, only existing operators may be overloaded.

(d) Base constructors are not inherited by derived classes.

(e) A **Car** class has an **is-a** relationship with **Steering** and **Brakes** classes.

(f) All virtual functions in an abstract bases class must be declared as pure virtual functions.

(g) Polymorphic programming can eliminate the need for switch logic.

(h) Friend classes and functions are inherited by derived classes.

(i) An object is an instance of a class.

(j) The insertion operator (<<) cannot be overloaded.

## Question 2 - 25 marks

(Compulsory)

The Mbabane Goverment Hospital attends to both In-Patients and Out-Patients.Out-Patients are treated and discharged on the same day. In-Patients are hospitalized and allocated to one of the several wards maintained by the hospital. Each ward has a unique identity number, a name, a telephone extension and the max number of patients it can accommodate. Each patient has a unique identity number, a firstname and lastname, a date of birth and
address.

The Staff of the hospital include doctors and nurses. Each staff member has a unique identity number, a firstname and lastname, address and date of birth. Doctors are Monthly paid and Nurses are hourly paid. Nurses are assigned to specific wards and doctors are divided into general practioners and specialists. General practioners attend to Out-Patients and Specialist doctors are assigned to specific wards and the area of specialisation is also known. For each patient, the full medical history is known, including description of diagnosis and treatment. For Out-Patients the doctor who attended to the patient and the date is also recorded. For In-Patient the admission and discharge dates are recorded.

(i) Using UML notation draw a OOA class diagram for the hospital system described above. Your diagram must show all classes, data members, member functions, instance connections, message connections and structures (Sub_classses and Aggregation). *10 marks*

(ii) Using UML notation, Add design details to class diagram obtained in (1) above. 5 marks

(iii) Using C++ notation, write class definition for all the classes as described in (1&2) above. *10 marks*

# Section B

- Answer any two (2) questions from questions 3 to 5 below.

## Question 3 - 25 marks

(Compulsory)

Re-write the following C++ program as follows:

- use a **class template definition** instead of **struct** definition of the **stack** data structure.
- Rewrite the function **void Create (Stack&)** as a constructor for the class.
- Rewrite the function **void ShowAll (Stack&)** function as a **friend** insertion operator **(<<)**
- The whole program must be rewritten to reflect the changes proposed above.

```
#include <iostream.h>
#define MaxSize 15
typedef int  DataType;

enum boolean {FALSE, TRUE};


struct Stack
{
   int size;
   int Items[15];
};

void  create (Stack&);
void  push (Stack&, DataType);
void  pop (Stack&);
boolean IsEmpty (Stack);
boolean  IsFull  (Stack);
DataType  Top (Stack);
void ShowAll (Stack&);

void main ()
{
  Stack S;
  create(S);
  push (S, 10);
  push (S, 20);
  push (S, 30);
  ShowAll (S);
  pop(S);
  ShowAll(S);
  push(S,40);
  push(S,50);
  ShowAll (S);
  pop(S);
  }
```

```
void create (Stack&  S)
{
  S.size = 0;

}


void  push ( Stack&  S, DataType  e)
{

 if  (!(IsFull(S)))
    S.Items[S.size++] = e;

}

void pop (Stack& S)
{
  if  (!(IsEmpty(S)) )
     S.size--;
}

boolean IsEmpty (Stack S)
{
  if (S.size == 0)
     return TRUE;
  else
    return FALSE;
}

boolean IsFull (Stack S)
{
  if (S.size == MaxSize)
      return TRUE;
  else
      return FALSE;
}


int Top  (Stack S)
{
  return (S.Items[S.size-1]);
}


void ShowAll (Stack& S)
{
  while ( !(IsEmpty(S)) )
  {
    cout << Top(S) <<  "    " ;
    pop(S);
  }
  cout << endl;
}
```

## Question 4- 25 marks

(i) What is a function template. *2 marks.*

(ii) Explain the advantages of using function templates. *3 marks*

(iii) What is the standard template library (STL). *4 marks*

(iv) Write a function template for a **Max** function that takes two data values as arguments and returns the largest value. *6 marks*

(v) Write a recursive function, ***IntegerPower*** *(X, n)*, that computes and returns the value of $X^n$ *10 marks*

## Question 5- 25 marks

(i) Assume that the charge for sending a parcel overseas is calculated as follows. First, its weight is rounded up to the nearest multiple of 15 grams. Then the charge is computed using the following table;

| **Weight** (*grams*) | **Charge** (*cents*) |
|---|---|
| 15 | 12 |
| 30 | 22 |
| 45 | 31 |
| 60 | 36 plus 2 per each completed 1000 km |
| 75 and over | 40 plus 3 per each completed 1000 km |

Write a C++ function **ComputeCharge** that takes the *Weight* of the parcel and the *Distance*, as arguments, and returns the Charge in cents. *10 marks*

(ii) Write a C++ function **DoubleSpace** *(ifstream InFile, ofstream OutFile)* that takes an input stream, *InFile*, as input and copies all the contents of InFile to an output stream, *OutFile*. The lines in OutFile must be double spaced. That is there must be at least one blank line between any consecutive lines in OutFile. The figure below shows a sample InFile and the expected double spaced OutFile.

**InFile** – *Single Spaced*

Good Hamlet,
Cast thy nited color
And look like a friend to Denmark

**OutFile** – *double spaced*

Good Hamlet,

Cast thy nited color

And look like a friend to Denmark

*15 marks*