University of Swaziland
Department Of Computer Science
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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.*

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SECTION A

- **Answer all questions in this section. Questions 1 and 2 are based on the following case description.**

You have been asked to write a program to be used by your small community library at Emvakwelitje in Mbabane. The library has books, videos and CDs that it loans to its users. All library materials have a unique identification number and a title. In addition, books have one or more authors, videos have one producer and one or more actors, while CDs have one or more entertainers. The library maintains one or more copies of each library item (book, video or CD).

Copies of all library materials can be loaned to users. For every loan, the library records the user, the loan date and time, the return date and time. For users, the library maintains their name, address and phone number.

QUESTION 1

Draw a class diagram for the description above. Your diagram must show all attributes, and associations, where appropriate. *25 Marks*

QUESTION 2

(i) Add design attributes to capture the associations shown in the diagram obtained in question 1 above. *3 Marks*

(ii) Using C++ notation, write suitable class definitions for your library system. All constructors must be defined, but for other member functions, only write the prototypes. *22 Marks*

SECTION B

- **Answer any two(2) questions from this section.**

QUESTION 3

(i) Explain the meaning of the following object-oriented terms

(a) Encapsulation. *2 marks*

(b) Class. *2 marks*

(c) Inheritance. *2 marks*

(d) Polymorphism. *2 marks*

(e) Message Passing. *2 marks*

(ii) Using clear examples, Explain the main difference between the following terms.

(a) Overloading and Overriding. 3 *marks*

(b) Operation polymorphism and Inclusion polymorphism. 3 *marks*

(c) Private base class and Public base class. 3 *marks*

(d) Private and Protected members. 3 *marks*

(e) Access and Implement member functions. 3 *marks*

QUESTION 4

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

(ii) Explain the advantages of using function templates. *2 marks*

(iii) What is the standard template library (STL). *2 marks*

(iv) Write a function template for a **Max** function that takes two data values as arguments and returns the largest value. *5 marks*

(v) Show how your function definition may be used to compare integer or character values. *4 marks*

(vi) Assume that for each student you know the name, age, and a list of courses they are taking. For each course, the title and code are known.

(a) Using C++ notation, define a class called **Course**.

(b) Using C++ notation. define a class called **Student** where the list of courses is represented as a vector of courses.

(c) Using your knowledge of class **Vector** in the STL, write a function Student member function **print()** that displays the name, age and the list of courses the student is enrolled in. *10 marks*

QUESTION 5

(i) What is a friend function/operator. *3 marks*

(ii) What are the advantages of a friend function/operator over an ordinary member function/operator. *2 marks.*

(iii) Using friends where appropriate, write a class definition for complex numbers, assuming the following operations may be performed on complex numbers. *20 marks.*

- *Re()* - returns real-part of complex number Z.
- *Im()* - returns imaginary-part of complex number Z.
- + - adds two complex numbers Z1 and Z2.
- * - multiplies two complex numbers Z1 and Z2.
- << - prints a complex number Z to output stream, say OutFile.

QUESTION 6

Using classes and objects, write a C++ program that reads, from a file, the names of candidates in a local election and the number of votes received by each candidate. A sample input files is:

```
Khumalo   5000
Malinga   4000
Fakudze   6000
Duffy     2500
Robinson  1800
```

The program should then output each candidate's name, the number of votes received and the percentage of the votes received by the candidate. Your program should also output the total votes counted and the winner of the election. A sample output is:

```
Candidate      Votes Received  % of Total Votes
Khumalo        5000            25.91
Malinga        4000            20.73
Fakudze        6000            31.09
Duffy          2500            12.95
Robinson       1800            9.33

Total Votes    19300

The winner of the Election is Fakudze.
```

25 marks