UNIVERSITY OF MAURITIUS

FACULTY OF ENGINEERING

SECOND SEMESTER EXAMINATIONS

MAY 2017

PROGRAMME	BSc (Hons) Electronics with Computer Science BSc (Hons) Information and Communication Technologies		
MODULE NAME	Software Engineering		
DATE	Friday 05 May 2017	MODULE CODE	CSE 2001Y(5)
TIME	09:30 – 12:30 Hrs	DURATION	3 Hours
NO. OF QUESTIONS SET	6	NO. OF QUESTIONS TO BE ATTEMPTED	5

INSTRUCTIONS TO CANDIDATES

Answer any 5 questions.

All questions carry equal marks.

Information sheet are attached.

Answer any 5 questions.

All questions carry equal marks.

Question 1 - [Total 20 marks]

Medcare is a clinic planning to computerize its system of recording patient details. Medcare has two types of patients, namely, Inpatients and Outpatients.

Inpatients are patients who are admitted to the clinic whereas **Outpatients** are patients who only get treatment at the clinic but are not admitted.

This system contains a **Patient** super class and two subclasses **Inpatient** and **Outpatient**.

a)   Describe **two** benefits of using inheritance.

b)   The class **Patient** has the following private data members:

Variables	Description
patient_ID	Each patient is given an ID, which is generated automatically by the system. It is recorded as an int, for example, the first patient has ID 10001, second patient 10002 etc.
Name	Records the name of the patient as a String
Address	Records the address of the patient as a String
Telephone_No	Records the telephone number of the patient as a String

The class **Patient** also has accessor methods for all 4 data members and a constructor that assigns the patient_ID and initialises the other data members. The class also has a method printPatientDetails() that displays the patient_ID, Name and Address of a patient.

Implement the class **Patient.**   **[6 marks]**

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(Question 1 continued)

c)   The class **Inpatient** inherits the class **Patient** and has 2 additional private data members:

- num_days   <int>   //*numbers of days admitted*
- rate   <double>   //*charges per day (in Rs)*

If the num_days is less than 5, the rate is Rs. 1500 and otherwise it is Rs. 1000.

The class Inpatient has a constructor that assigns the patient_ID, intialises the name, address, telephone_no, the stay_duration and the day_rate. The class also has accessor methods for its data members and a method printPatientDetails that prints the patient details including num_days and rate. This method also prints the total amount due by the patient.

Implement the class **Inpatient**.

[6 marks]

d)   The class **Outpatient** also inherits from the class **Patient** and has 1 additional private data members:

- num_treatment <int> *the number of treatments received by patient*

Treatments for outpatient are fixed at the price of Rs. 500 per treatment.

The class Outpatient has a constructor that assigns the patient_ID, intialises the name, address, telephone_no, the num_treatment. The class also has accessor methods for its data members.

Implement the class **Outpatient**.

[2 marks]

e)   A mother and a child both go to MedCare. The baby is admitted to the clinic whereas the mother receives treatment in the Outpatient Department. Create a class **Invoice** that creates an instance of Outpatient for the mother and an instance of Inpatient for the baby. The class should also display the total amount due by the mother and the child.

[2 marks]

Question 2- [Total 20 marks]

a) Describe **two** differences between an abstract class and an interface. **[4 marks]**

b) An abstract class **Vehicle** with the following private data members:

*   type_use <String> *//the use of the Vehicle: Personal or Commercial*
*   registration_year <int> *// the registration year of the vehicle*
*   engine_capacity <double> *// the capacity of the engine*

The class **Vehicle** has a constructor, which initializes the type of use, the year and the engine capacity. It also has one abstract method called Calculate_Insurance().

Implement the class **Vehicle.**

[4 marks]

c) The class **Motorcycle** and the class **Car** are concrete classes that extend the class Vehicle. The method Calculate_Insurance() should be implemented as follows:

Motorcycle	- The base insurance for a motorcycle is Rs. 2500. - For each year, Rs. 250 is added to the base insurance. For example: If a motorcycle is of year 2013, the total insurance = (Rs. 2500 + 4* Rs 250) = Rs. 3500 *You may assume a function Date.getYear() that returns the current year.*
Car	- The base insurance for a car is Rs. 5000. - For each year, Rs. 250 is added to the base insurance. - If the engine of the car is greater than 1000 cc, a surcharge of Rs. 1500 is added to the base insurance. - If the car is for commercial use, a surcharge of Rs. 2000 is added to the insurance For example: If a car is of year 2015, engine capacity 1300 cc and for commercial use, the total insurance = (Rs. 5000 + 2* Rs 250 + Rs 1500 + Rs. 2000) = Rs. 9000 *You may assume a function Date.getYear() that returns the current year.*

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(Question 2 continued)

Implement the **Motorcycle** class and the **Car** class.

[8 marks]

d)   Implement a class **VehicleRegistration** that creates two instances of **Motorcycles** and three instances of **Cars** and stores them in an array. Your class should also display the total insurance of all the vehicles. *(You may use fictitious attributes for your instances).*

[4 marks]

Question 3 - [Total 20 marks]

a)   Give two types of inner classes, specifying their definition points and their visibility in the class in which they are defined.

[4 marks]

b)   Differentiate between time slicing and multiprocessing in the execution of threads.

[4 marks]

c)   A class LoginFrame which is a subclass of the class JFrame has to cater for multiple access through threads in Java. Explain how this can be achieved, giving the Java code for the class definition only.

[3 marks]

d)   Briefly describe the five stages of the lifecycle of a thread.

[5 marks]

e)   Consider the class Thread_Demo in Figure 1. The method run() should do the following:

- Print a message "Thread will now sleep"
- Allow the Thread to sleep for 50 milliseconds
- Print a message " Thread is no longer sleeping"

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(Question 3 continued)

```java
public class Thread_Demo extends Thread
{
   private Thread t;
   private String threadName;

   public Thread_Demo( String name) {
      threadName = name;
      System.out.println("Creating " +  threadName );
   }

   public void run() {

   //This method should:
   //1. print a message " Thread will now sleep"
   //2. allow the thread to sleep for 50 milliseconds
   //3. print a message "Thread is no longer sleeping"

   }

   public void start () {
      System.out.println("Starting " +  threadName );
      if (t == null) {
         t = new Thread (this, threadName);
         t.start ();
      }
   }
}
```

Figure 1

[4 marks]

Question 4

Read the following problem statement.

The senior management of CDAC School of Computing intends to have an **integrated library system** (**ILS)** built so as to track items owned, orders made, bills paid, and users who have borrowed the items. The system shall be user friendly and implemented using Java development platform.

The ILS usually comprises of a relational database, software to interact with that database, and several graphical user interfaces. The database shall store information about borrowing items, namely: books, journals and conference proceedings. Each item shall have a unique ID, a type (book, journals or proceedings), number of copies, etc. The database also keeps track of the borrower, the borrowing date and the due date. Books are lent out for a period of two weeks whereas the other items (journals and proceedings) for a period of 3 days.

Each library user will have a unique ID and other personal details (name, address etc) in the database that allows the ILS to track its activity. The system administrator or library staff will have to register library users with the system before items can be borrowed. The ILS system weekly identifies a list of borrowers who are late. A sheet listing out overdue items and penalties will be mailed to late borrowers. The format of this sheet shall be based on the document "LibPenFees34.txt". A user may be suspended if items returned are in bad condition (mishandling) or if penalties are not resolved. ILS will operate with another system that will generate automatic email notification, a feature that it will use to notify late borrowers.

From time to time, the library senior staff track the process of new acquisitions (ordering, receiving, and invoicing materials). Automated cataloguing includes classifying and indexing materials. When new materials are received, they have to be first classified and then placed properly in the appropriate shelves and rows. The item is also indexed properly for search purposes. The ILS will provide to the library users a set of local computer access points where they can search items of the library, based on author name, title or topic keywords. After having fetched the items from the shelves with the help of the search results,

Question

(a)   Who is a stakeholder? List four stakeholders that might be a source of requirements for the above system.

[3 marks]

(b)   Identify three functional & three non-functional requirements for the case-study given above.

[6 marks]

(c)   With justifications, state whether the non-functional requirements identified in (b) are verifiable? If not, rewrite them so as they are verifiable.

[3 marks]

(d)   What is meant by an omission in requirements? From your own experience, identify a functional requirement that may have been omitted.

[3 marks]

(e)   The development team feels that the requirements are more or less known. The budget for the software construction is tight. Moreover, for training purposes, the users would like to experiment with the system before the final system is installed. Select a development life-cycle model that will be most appropriate for the above system. Justify your answer.

[5 marks]

Question 5

(a) (i) Coupling and cohesion are two attributes of a good program design. State any other two attributes of a good program design.

[2 marks]

(ii) State the difference between coupling and cohesion.

[2 marks]

(iii) Explain the different types of coupling that exists between two functions.

[4 marks]

(iv) The following code shows two functions Draw() and RoutineX(). With Justifications, state which type of coupling they exhibit.

[2 marks]

```
public Draw( String str){
        String shapelist = {"Circle", "Rhombus", "Rectangle", "Triangle"};
        int shape = random() % 4;
        RoutineX(shapelist[shape]);
}

public RoutineX(String command){
        if (command.equals("Circle") {
                drawCircle();
        }
        else {
                drawRectangle();
        }
}
```

(a) The tables below show the information domain characteristics for a project and the complexity value associated with each count respectively.

Domain characteristics	Number	Weighting
User inputs	53	Simple
User outputs	40	Average
User inquiries	20	Average
DB Tables	15	Average
External interfaces	4	Complex

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(Question 5 continued)

Parameter	Simple	Average	Complex
User inputs	3	4	5
User outputs	5	6	8
User inquiries	3	6	8
DB Tables	9	11	16
External interfaces	7	9	12

(i) State the strengths of function-oriented metrics over size-oriented metrics.
[2 marks]

(ii) Calculate the function point value for the above project. Assume an average complexity for all "technical complexity factors" (that is 2.5).
[4 marks]

(iii) From records of past projects undertaken in the company, the average productivity and the average cost have been 25 function points per person per month, and Rs 15 000 per function point respectively. Assuming the development team of the company consists of 15 developers, estimate the duration and cost of the above project.
[4 marks]

Question 6

(a) (i) What is the difference between white box and black box testing?

(ii) Which test cases are written first: white boxes or black boxes? Explain.
[2 + 2 marks]

(b) (i) A defect which could have been removed during the initial stage is removed in a later stage. How does this affect cost?

(ii) Explain the metric of Defect Removal Efficiency (DRE) with respect to the process quality assurance, and how a metric value is used to interpret the efficiency of this process.
[2 + 2 marks]

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(Question 6 continued)

(c)   Consider the following code:

```
class LinearSearch {

  public static void main(String args[]){
    int c, n, search;
    int array[] = {45,36,89,4,99};

    System.out.println("Enter value to find");
    search = in.nextInt();

    if (search < 0)
        System.exit(2);

    for (c = 0; c < array.length; c++){

      if (array[c] == search){
        /* Searching element is present */
        System.out.println(search + " is present at location " + (c +
1) + ".");
          break;
      }//if
    }//for

    if (c == n)  /* Searching element is absent */
      System.out.println(search + " is not present in array.");

  }//main
}//class
```

(i)   Derive the flow graph for the above function.

(ii)   Define cyclomatic complexity. Determine the cyclomatic complexity of the above function.

(iii)   After identifying the independent paths, derive a full set of test cases to fully test the above function.

[4 + 3+ 5 marks]

END OF QUESTION PAPER

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