

**SLIATE**

SRI LANKA INSTITUTE OF ADVANCED TECHNOLOGICAL EDUCATION

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**Higher National Diploma in Information Technology**  
**Second Year, First Semester Examination – 2019**  
**HNDIT2313/IT3103 – Object Oriented Analysis and Design**

## **Model Answers**

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### **Question 01**

- (i). Differentiate between object oriented analysis and object oriented design.

**Object oriented analysis can be defined as investigation of objects. Design means collaboration of identified objects.**

**The most important purpose of OO analysis is to identify objects of a system to be designed. Analysis is also done for an existing system.**

**An efficient analysis is only possible when we are able to start thinking in a way where objects can be identified. After identifying the objects their relationships are identified and finally the design is produced.**

(06 Marks)

- (ii). Define the terms coupling and cohesion in the context of object oriented programming. Explain how coupling and cohesion can lead to either good or bad software design.

**Cohesion is the indication of the relationship within module. Coupling is the indication of the relationships between modules.**

**Cohesion is a degree (quality) to which a component / module focuses on the single thing. Coupling is a degree to which a component / module is connected to the other modules.**

(04 marks)

**Good design should go for high cohesion and low coupling.**

(01 mark)

(iii). Give the object oriented terminology for each of the following object oriented features and supply an example of code that illustrates the feature:

- a) A blueprint for an object which defines all the data items contained in the object and the operations that are permitted for the data.

**This is known as a class** (01 mark)

**For any correct example** (02 marks)

- b) A representation of something within the domain that the program models which contains values of data and which implements operations on that data.

**This is an object** (01 mark)

**For any correct example** (02 marks)

- c) An operation which will manipulate the data contained in an object.

**This is known as a method** (01 mark)

**For any correct example** (02 marks)

(09 marks)

**(Total 20 marks)**

### **Question 02**

- (i). Define the terms encapsulation and data hiding and describe the relationship between them.

**Encapsulation relates to the packaging (binding) together of data and operations (e.g., to form classes in the object oriented paradigm). A common objective of encapsulation is to prevent data from being visible outside the encapsulated unit in which it is defined, except through methods that can therefore control access and monitor the validity of that data they arbitrate. In that sense, it also accomplishes data hiding where class members that we wish to be inaccessible outside the class are designated private.** (02 marks)

**Data hiding is a more general term that entails secreting certain details of an implementation (data or functions) away from the user to prevent them being accidentally or intentionally damaged, and also to simplify the programmer's view of the system. This may be via through the use of private members in a**

reused class (i.e., encapsulation), but can also be implemented using libraries, the invocation of pre-compiled program components, and other means.

(02 marks)

- (ii). How does method overloading differ from method overriding?

**Method Overloading:** Having several versions of the same method name, but with different signatures. The appropriate version is executed, depending upon the arguments passed when the method is invoked. (02 marks)

**Method Overriding:** Creating of two or more methods with the same name and signature in different classes in the class hierarchy (i.e., super-class and sub-class), such that (for example) a sub-class version can overshadow an inherited (super-class) version. (02 marks)

- (iii). The atoms of different elements have different numbers of protons, neutrons and electrons. Electrons are negatively charged, protons are positively charged, and neutrons have no charge.

- a) Using C++ programming language, write a definition for an atom class that contains:

- i. fields for storing the numbers of protons, neutrons and electrons with appropriate visibility
- ii. setter and getter methods for manipulating these fields, ensuring that the minimum value for electrons and protons is 1, and the minimum value for neutrons is 0
- iii. a constructor that initialises new objects of atom to be the smallest element (Hydrogen), for which the number of protons is 1, the number of electrons is 1, and the number of neutrons is 0.

```
Class atom
{
    private:
        int protons, neutrons, electrons;
    public:
        atom() {
            protons = 1;
            neutrons = 0;
            electrons = 1;
        }
        boolean setProtons (int P)
        {
            if (P > 0)
```

```

        { protons = P;
          return true;
        }
        return false;
      }
      boolean setNeutrons (int N)
      {
        if (N > 0)
        { neutrons = N;
          return true;
        }
        return false;
      }
      boolean setElectrons(int E)
      {
        if (E > 0)
        { electrons = E;
          return true;
        }
        return false;
      }
      int getProtons() { return protons; }
      int getNeutrons() { return neutrons; }
      int getElectrons() { return electrons; }
    };

```

Variable declaration ----- (01 mark)

Constructor -----(02 mark)

Setters ----- (03 marks)

Getters -----(03 marks)

- b) Write a new method for the atom class called getAtomicMassNumber that will calculate and return the atomic mass number of the atom.

**(Hint:** Atomic mass number of an atom = number of protons + number of neutrons)

**public int getAtomicMassNumber()**

**{ return protons + neutrons; }**

(03 marks)

**(Total 20 marks)**

### Question 03

- (i). What is the main purpose of use case modeling?

**To capture the software's functional requirement.**

(03 marks)

- (ii). Describe the meaning of <<extend>> and <<include>> in a UML use-case diagrams.

**<<extend>> implies a generalization relationship in which the extending use-case continues (i.e. adds more functionality to) the behaviour of the base use case. The extending use case is optional and may be invoked depending upon a condition.**

**(2.5 marks)**

**<<include>> implies a generalization relationship that entails the inclusion of a behaviour defined in another use-case. The included use case is mandatorily invoked, and the base use case is incomplete without it.**

**(2.5 marks)**

- (iii). Draw a use case diagram for the following Hospital Management System.

The hospital has several specialized departments like Cardiology, Gynecologic, Orthopedics, Pediatrics, ENT etc. OPD is another independent department. A doctor is only associated with one specialized department at a time though he/she can be a member of the OPD (Outside Patients Department). Each doctor has a visiting time and day in a week.

At reception the patient details are entered and the fees are also taken and the patient is tracked on the basis of the ID generated. In routine a patient can visit the doctors either directly selecting a doctor or by getting admitted to the hospital and then a doctor visits the patients.

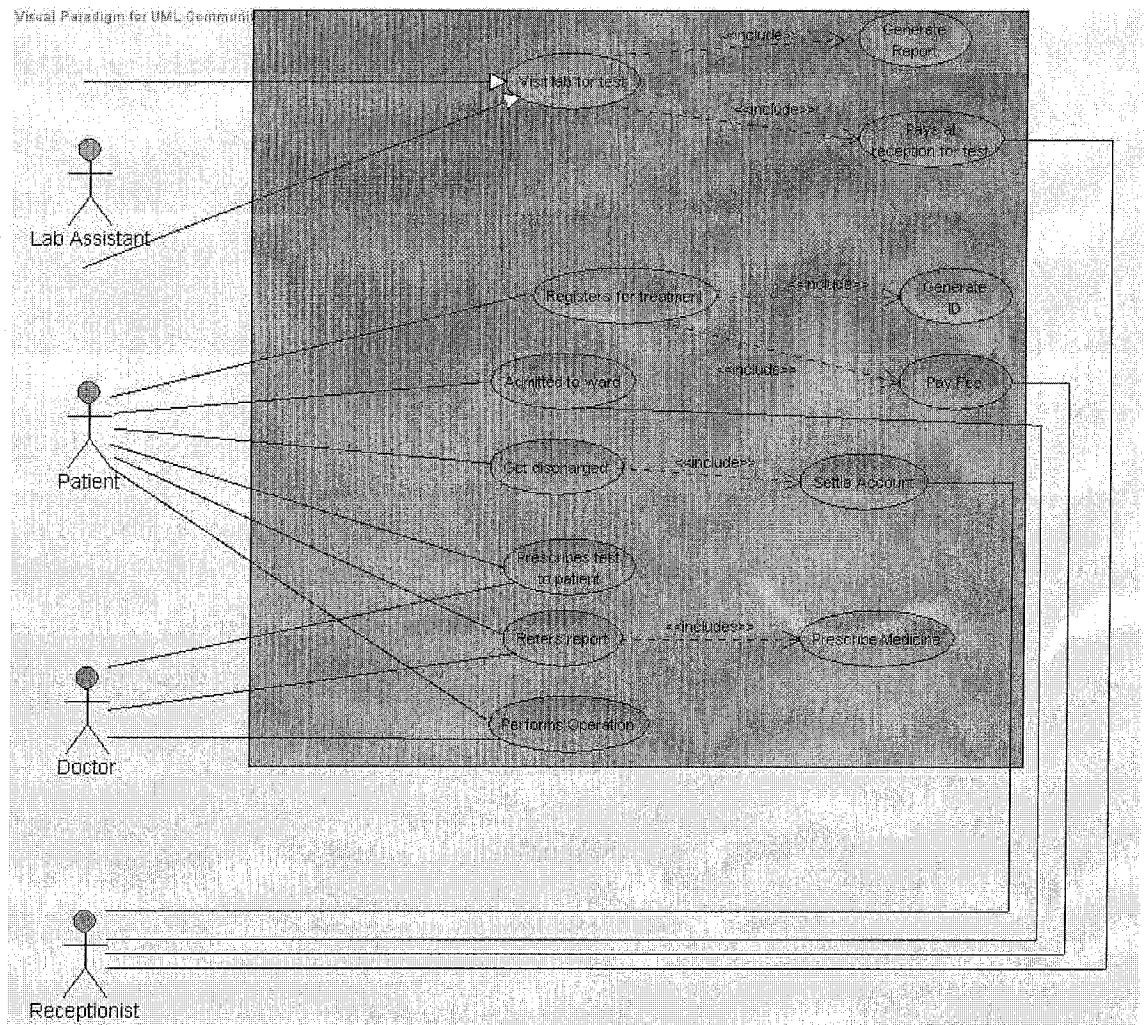
A doctor can prescribe tests for the patient to perform. The patient visits the lab to get done the tests prescribed by his/her doctor. The reports are given to the patient. The payments pertaining to the tests are done at the reception. Referring the reports, the doctor prescribes the patient medicines or further tests or is asked to get admitted.

A patient is admitted into a ward of a specialized department (if available) as per the doctor's prescription. The number of wards is limited and if there is no vacant ward the admission of the patient is rescheduled.

As per the prescription of the doctor the patient is operated on a specified date and time as decided by the doctor who is doing the operation.

After the completion of the treatment a patient may get discharged on an advice of a doctor and upon the complete payment of all due charges at the reception. On

payment of full dues the reception generates a discharge ticket for the patient.



(12 marks)

(Total 20 marks)

#### Question 04

- (i). Briefly describe the purpose of drawing component diagram.

**Component diagrams represent a set of components and their relationships.**

**So Component diagrams represent the implementation view of a system.**

**During design phase software artifacts (classes, interfaces etc.) of a system are arranged in different groups depending upon their relationship. Now these groups are known as components.**

**Finally, component diagrams are used to visualize the implementation.**

(03 marks)

- (ii). Show how composition and aggregation inter-class relationships would be represented in a UML class diagram. Briefly describe the difference between them.

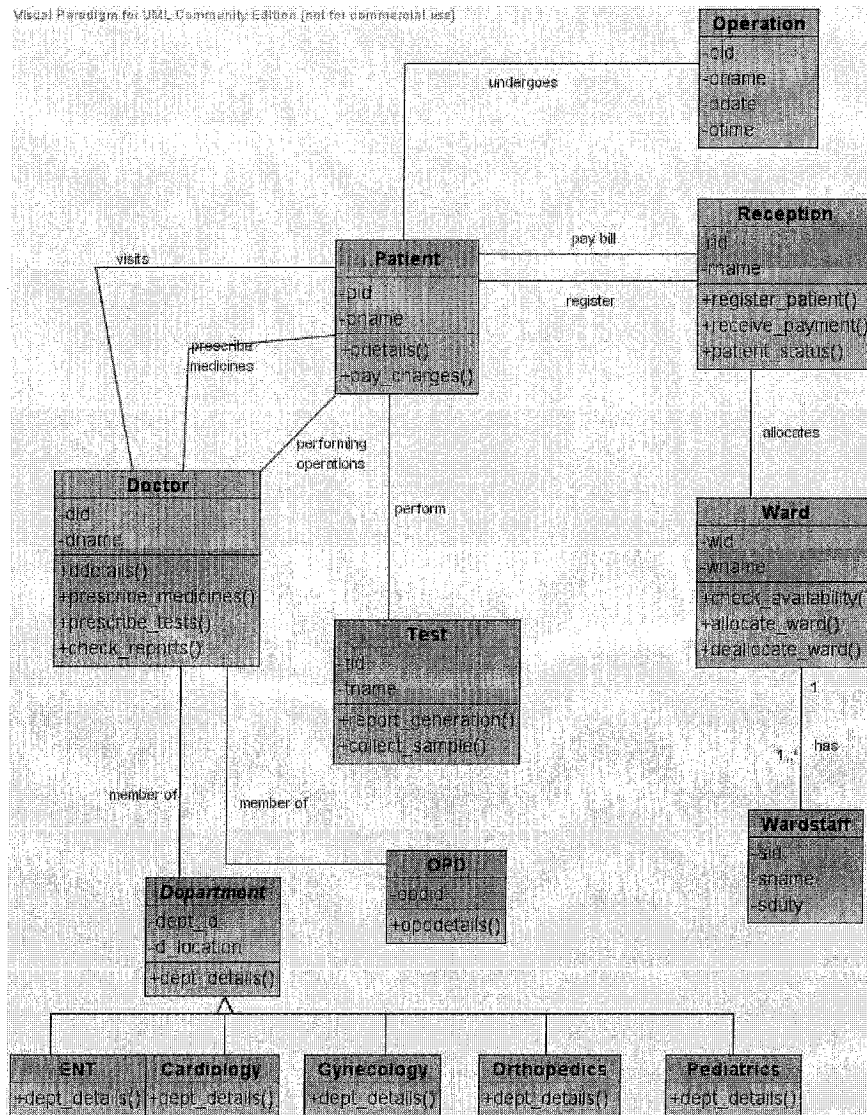
**aggregation: empty diamond**

**composition: filled diamond** (02 marks)

**Aggregation implies that a relationship exists between two classes, but each class can exist independently (i.e., they are separable, like a book and a library). It is a “part of” or “has a” relationship.** (1.5 marks)

**Composition is a stronger form of aggregation, wherein there is an ownership relation such that if an owner object is destroyed, the owned objects are also destroyed (i.e., they are non-separable and cannot exist/function independently). It is sometimes called an “owns a” relationship.** (1.5 marks)

- (iii). Draw a class diagram for the Hospital Management System given in question number three (03) part three (iii).



(12 marks)

(Total 20 marks)

### Question 05

(i). State the main features of Unified Software Development Process (USDP).

- Iterative and incremental development.
- Component based development
- Requirements driven development
- Configurability
- Architecture centrism
- Visual modeling techniques

(1 x 4 = 04 marks)



- (ii). Mention two differences between activity diagram and sequence diagram.

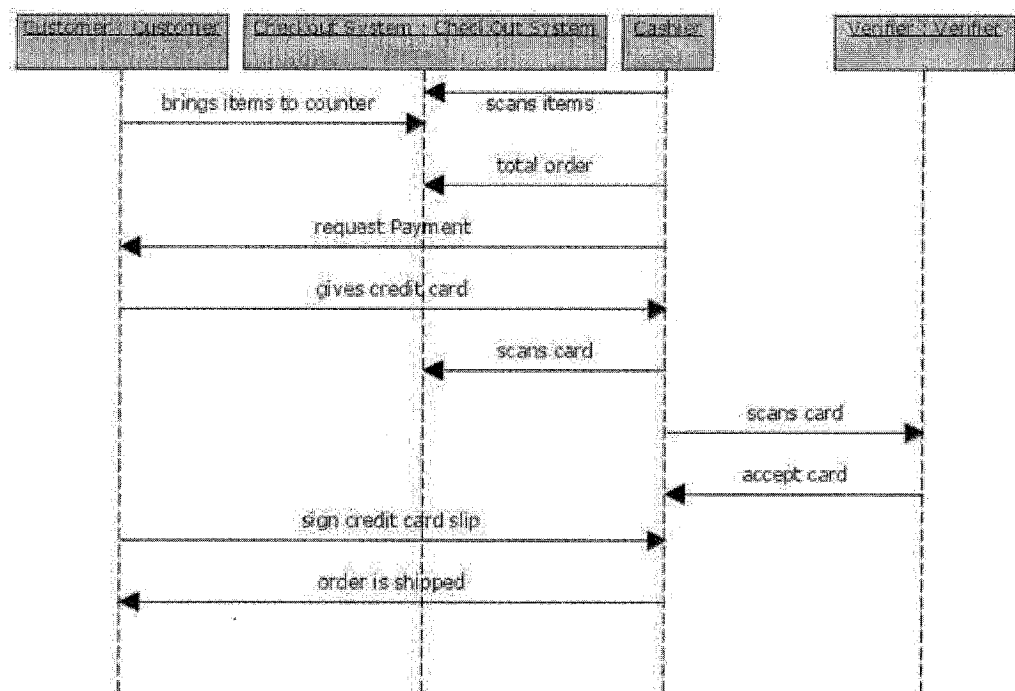
Sequence diagram	Activity diagram
The Sequence diagram represents the UML, which is used to visualize the sequence of calls in a system that is used to perform a specific functionality.	The Activity diagram represents the UML, which is used to model the workflow of a system.
The Sequence diagram shows the message flow from one object to another object.	The Activity diagram shows the message flow from one activity to another.
Sequence diagram is used for the purpose of dynamic modelling.	Activity diagram is used for the purpose of functional modelling.

(2 x 2 = 04 marks)

- (iii). Consider a book store in a shopping mall. Prepare a sequence diagram for bookstore checkout system.

A brief description is given below.

The customer selects the books from racks to purchase. The customer brings selected books to cashier. The cashier scans each item with checkout system to prepare an order. The cashier requests to customer for payment. The customer gives credit card to cashier. The verifier and checkout system scans the card. The verifier accepts the card and payment is accepted. Customer signs the credit card slip. The purchased books are handed over to customer.



(12 marks)

(Total 20 marks)

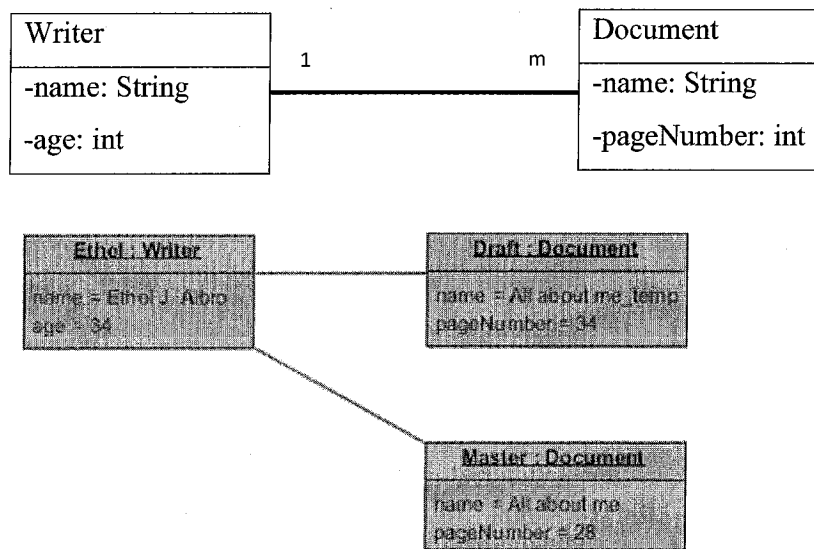
### Question 06

(i). Briefly describe the purpose of drawing deployment diagrams.

- Visualize the hardware topology of a system.
- Describe the hardware components used to deploy software components.
- Describe the runtime processing nodes.

(04 marks)

(ii). Draw a sample object diagram for the following class diagram.



Object Diagram

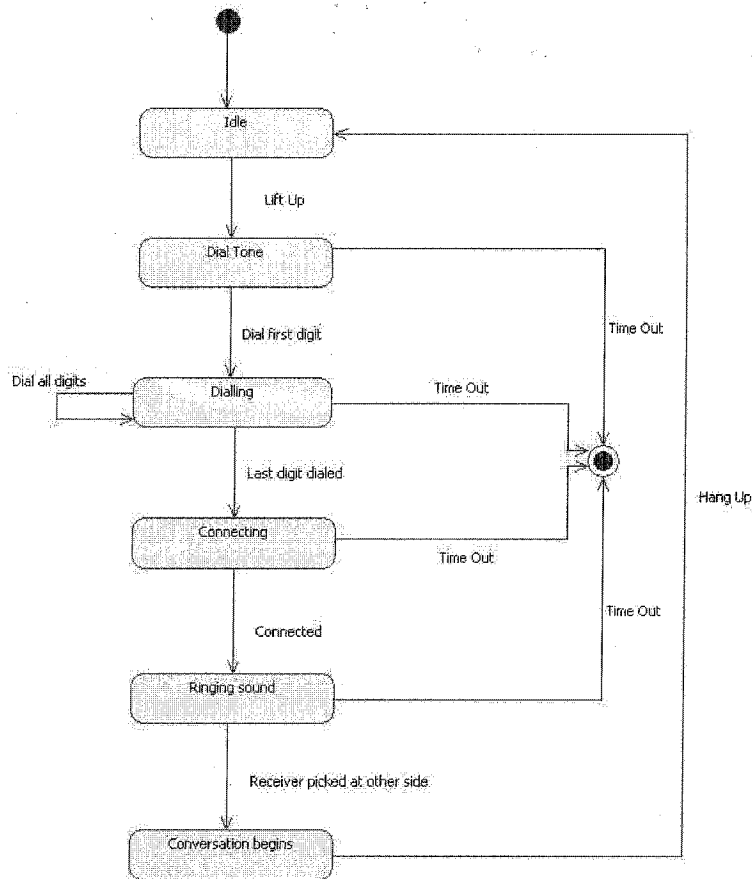
(04 marks)

- (iii). Consider the class for telephone line with following activities and states:
- As a start of a call, the telephone line is idle. When the phone receiver is picked from hook, it gives a dial tone and can accept the dialling of digits.
- If after getting dial tone, if the user doesn't dial number within time interval then time out occurs and phone line gets idle.
- After dialling a number, if the number is invalid then some recorded message is played.

Upon entry of a valid number, the phone system tries to connect a call & routes it to proper destination.

If the called person answers the phone, the conversation can occur. When called person hangs up, the phone disconnects and goes to idle state.

Draw the state transition diagram for above description of telephone line.



(12 marks)

(Total 20 marks)