National University of Computer and Emerging Sciences, Lahore Campus

| Course Name:	Software Design & Analysis	Course Code:	CS3004
Program:	BS (CS)	Semester:	Fall 2021
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Paper Date:	10 Jan 2022	Weight:	
Section:	All sections	Page(s):	6
Exam Type:	Final		

Name:_____ Roll No._____ Sec: _____

Question 1 (10 marks)

Consider the following system description:

A hospital wants to store basic information about patients, staff and admissions. Assume there are three types of staff: doctors, nurses and cleaners. A staff member can be assigned duty in any ward any time.

The hospital has three types of wards: emergency, regular and ICU. Each ward provides different services, and so has different charges. During the stay, a patient may move from one ward to another.

Give a class diagram showing classes, associations and multiplicity. Show any important data members or functions.
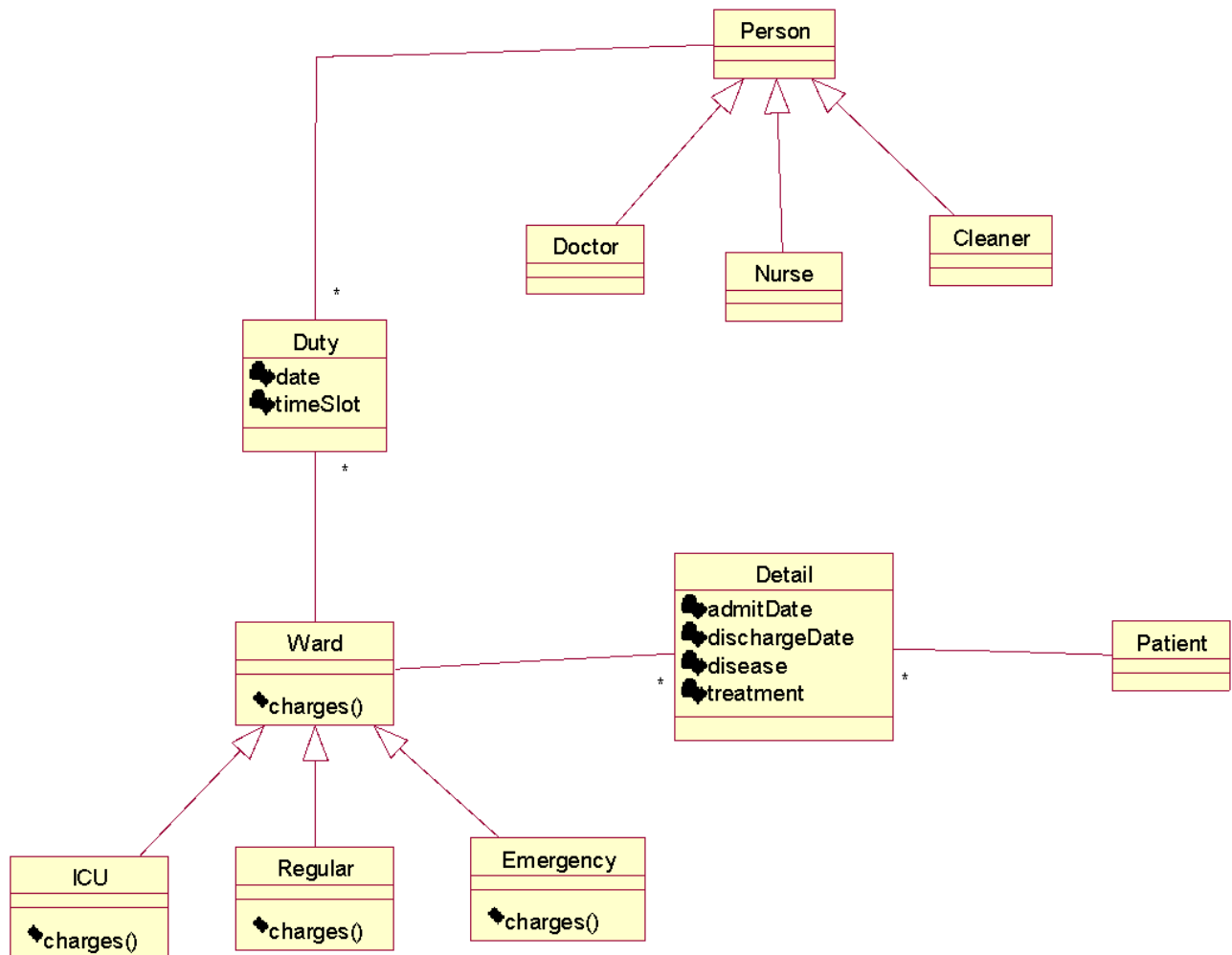
Question 2 (20 marks)

Consider a simple graphical diagram. A Graphical element in the graphical diagram can be a rectangle, a square, a line, or a simple graphical diagram. A simple graphical diagram may contain any number of rectangles, squares or lines. It may also contain one or more other simple graphical diagrams. Each graphical element has a unique alphanumerical serial number and it consumes a certain amount of area. The area covered by a line is equal to 1. The area consumed by a rectangle is equal to the product of its height and its width ; squares' area can be calculated by multiplying its side length. The area consumption of a simple graphical diagram is equal to the sum of the area of all the rectangles, squares, lines and simple graphical diagrams contained in it.

(a) Which design pattern is suitable for designing the simple graphical diagram described above? [Note: An invalid answer to this part will result in a zero in the entire question.]

(b) Draw a UML class diagram showing the design of the simple graphical diagram described above. This design must adhere to the structure of the design pattern chosen above.

(c) Write code for all the classes. You can use either C++ or Java. Clearly mention your choice.
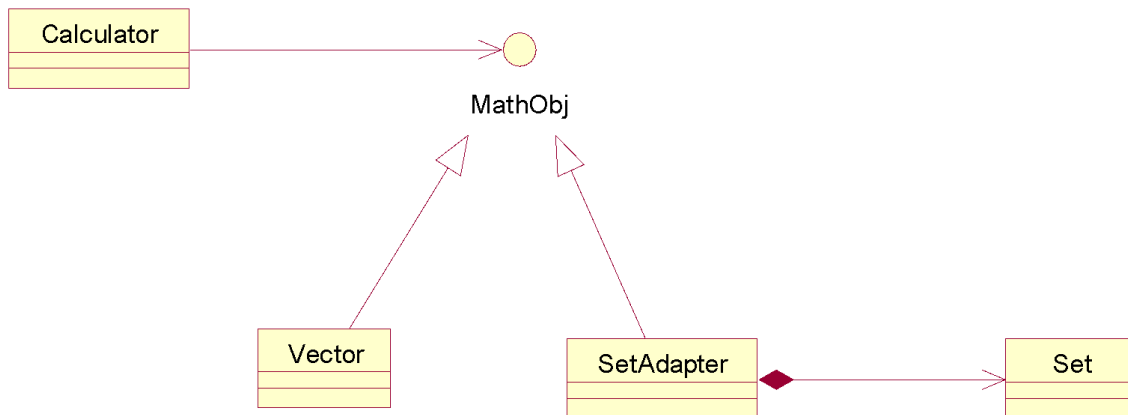
Question 3 (10 marks)

Consider the following class diagram:

Calculator

→

Vector

*

The calculator performs various computations over the vectors.

(a) In future, we may add new classes (such as Matrix) in the system. So change the design to make it scalable (easy to maintain).

(b) A new class, say Set, is provided by an external vendor and cannot be changed. How would you incorporate this class? Show your design.
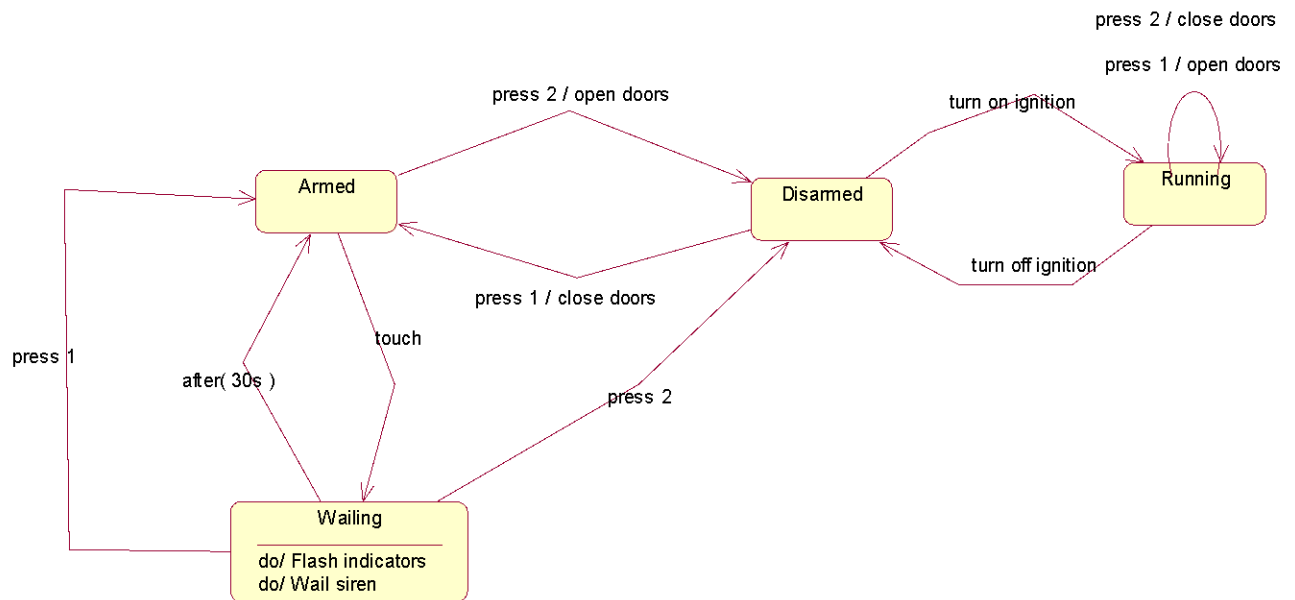
Calculator

→ ◯
MathObj

Vector

SetAdapter

◆→

Set

Question 4 (10 marks)
Consider a car security system (CSS) operated through a remote control. Assume the remote control has only two buttons: button 1, and button 2. Pressing button 1 arms the system, while pressing button 2 disarms the system. The system locks the doors on entering the armed mode, and unlocks the doors on entering the disarmed mode.

If someone touches the car while in the armed mode, the CSS enters the wailing mode. While in the wailing mode, the CSS continuously flashes the indicators and wails a siren. This wailing continues for 30 seconds, afterwards the CSS automatically stops wailing and returns to the armed mode. The wailing can be interrupted before 30 seconds by pressing either of the two buttons. If the button 2 is pressed then the next mode is disarmed, otherwise armed.

While in the armed mode or in the wailing mode, the driver cannot turn on the ignition. This can be done only in disarmed mode. When the ignition is turned on, the CSS enters the running mode; and turning off the ignition causes the system to go back to the disarmed mode. While in the running mode, pressing button 1 or 2 results in locking or unlocking the doors respectively; it does not change the mode.

Your task is to draw a UML state diagram for the afore-mentioned CSS.

Question 5 (10 marks)

Consider the following system:

Part	Shipment	Supplier
⬥dsc	⬥date ⬥quantity	⬥name

* (between Part and Shipment)   * (between Shipment and Supplier)

A supplier may supply multiple parts, and a part can be provided by more than one suppliers.

Now give a sequence diagram to find all the suppliers of a given part (names required). You may add any functions required.

i:Interface   p:Part   m:Shipment   s:Supplier

allSuppliers

For each "m" in "p"

getName

getName