	Course:	Software Design & Analysis	Course Code:	CS3004
	Program:	BS (CS)	Semester:	Fall 2023
	Duration:	180 Minutes (3 Hours)	Total Marks:	100
	Paper Date:	29-Dec-23	Weight	40%
	Section:	All	Page(s):	10
	Exam:	Final		

Instruction/Notes:

Attempt all questions on the question paper. Neither use nor submit any extra sheet.

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Question 1 (Max. Marks = 1 x 20 = 20) [CLO 1]

Circle the correct choice in each of the following MCQs. Only one option should be circled. Think before choosing the correct choice. Cutting will result in disqualification of answer.

1. _____ is the sharing of attributes and operations among classes based on a hierarchical relationship.
   a. Association
   b. Composition
   c. Reflexive association
   d. Inheritance
   e. Abstraction

2. _____ lets you focus on essential aspects of an application while ignoring the details.
   a. Abstraction
   b. Encapsulation
   c. Classification
   d. Relationship
   e. Inheritance

3. All of the following are correct except
   a. Aggregation is a strong kind of association
   b. Composition is a strong kind of aggregation
   c. Composition is a strong kind of association
   d. Aggregation is a strong kind of composition

4. "A dining philosopher uses a fork" should be represented by a/n _____
   a. Association
   b. Aggregation
   c. Composition
   d. Inheritance
   e. Polymorphism

5. "University consists of many departments." should be represented by a/n _____
   a. Association
   b. Aggregation
   c. Composition
   d. Inheritance
   e. Polymorphism

6. Sequence diagrams show the
   a. static picture of the system
   b. dynamic picture of the system
   c. events and transitions
   d. classes and their attributes

7. In a UML state diagram, can a do-activity be interrupted by an event that is received dur
   its execution?
   a. Yes
   b. No

8. In a UML use case diagram, use case extension indicates _____
   a. An optional scenario
   b. A generalization-specialization relationship between use cases
   c. A deviation from the UML standard
   d. All of the above

9. What is coupling between two classes?
   a. The degree to which these two classes are connected to each other
   b. The degree to which these two classes are independent of each other
   c. The degree to which these two classes share a common interface
   d. None of the above

10. Which design pattern is used to create objects without specifying the exact class to create
   a. State
   b. Template
   c. Factory Method
   d. Composite

11. Which design pattern defines a one-to-many dependency among objects?
   a. Singleton
   b. Template Method
   c. Observer
   d. Factory Method

12. Which phase of the SDLC focuses on "understanding the problem"?
   a. Analysis
   b. Design
   c. Planning
   d. Maintenance

13. Which design pattern ensures that a class has only one instance and provides a global point of access to it?
   a. Singleton
   b. Composite
   c. Observer
   d. Factory Method

14. Which design pattern defines the skeleton of an algorithm in an operation, deferring some steps to subclasses?
   a. State
   b. Template Method
   c. Factory Method
   d. Composite

15. When a class replaces the implementation of a method that it has inherited it is called _____
   a. Overloading
   b. Overriding
   c. Overwriting
   d. None

16. When a (derived) class inherits features (data and operations) from another derived class, it is called as _____
   a. Complex inheritance
   b. Multilevel inheritance
   c. Multiple inheritance
   d. None

17. According to the _____, there should be only one reason to change a class.
   a. ISP
   b. SRP
   c. OCP
   d. All of the above

18. Which phase of the SDLC has a major focus on "how the system will work"?
   a. Analysis
   b. Design
   c. Planning
   d. Maintenance

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19. A high value of the coupling between objects (CBO) metric represents a good design.
   a. True
   b. False

20. A good design helps in
   a. Programming
   b. Testing
   c. Maintenance
   d. All of the above
   e. None of the above

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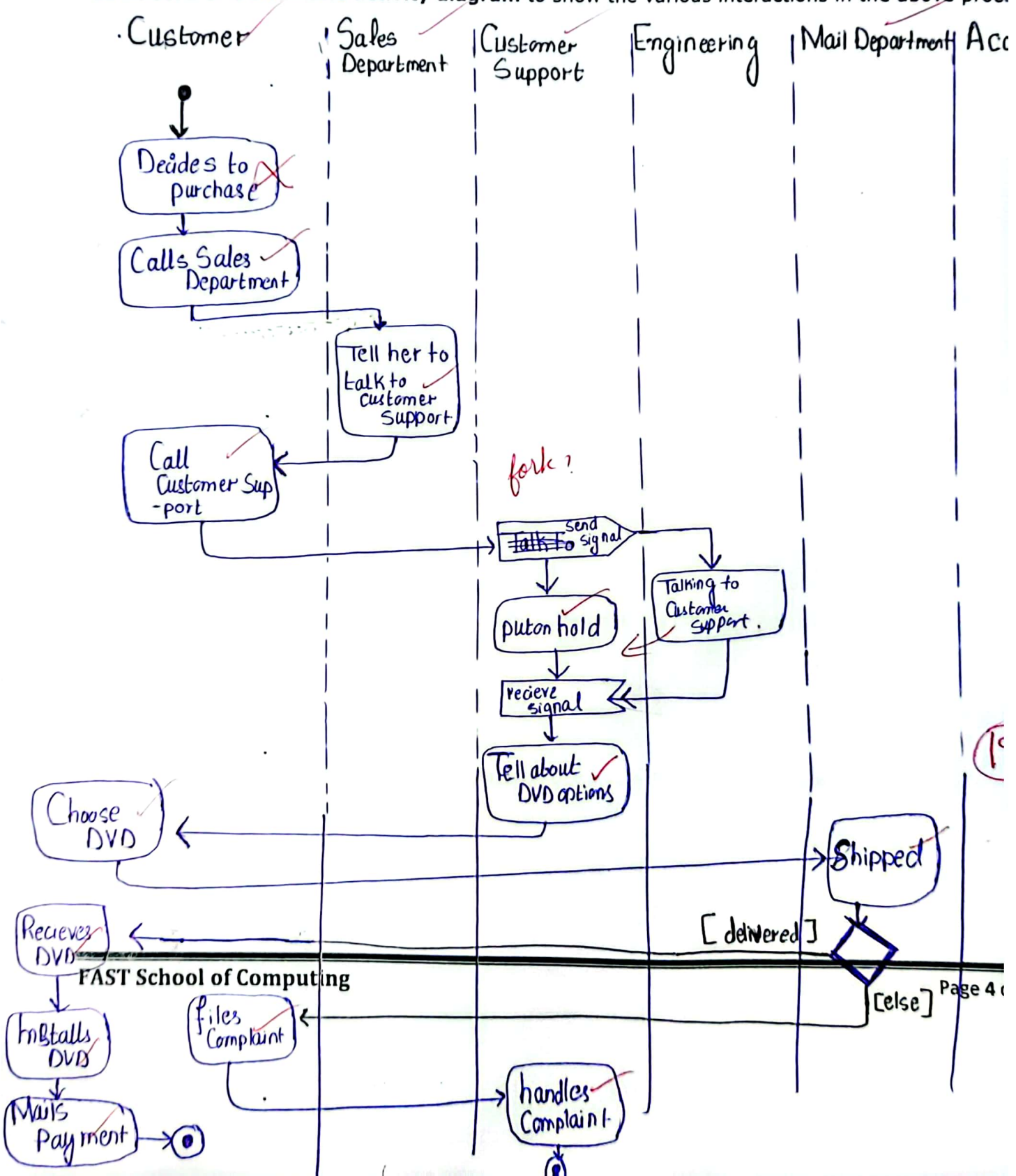
Question 2 (Max. Marks = 20) [CLO 4]

A customer decides to upgrade her PC and purchase a DVD player. She begins by calling the sa department of the PC vendor and they tell her to talk to customer support. She then calls custor support and they put her on hold while talking to engineering. Finally, customer support tells customer about several supported DVD options. The customer chooses a DVD and it is shipped the mail department. If the order is delivered, the customer receives the DVD, installs it, and t mails her payment to accounting. Otherwise, the customer files a complaint that the order was delivered and customer support handles the complaint.

Construct a UML **swimlane activity diagram** to show the various interactions in the above proce



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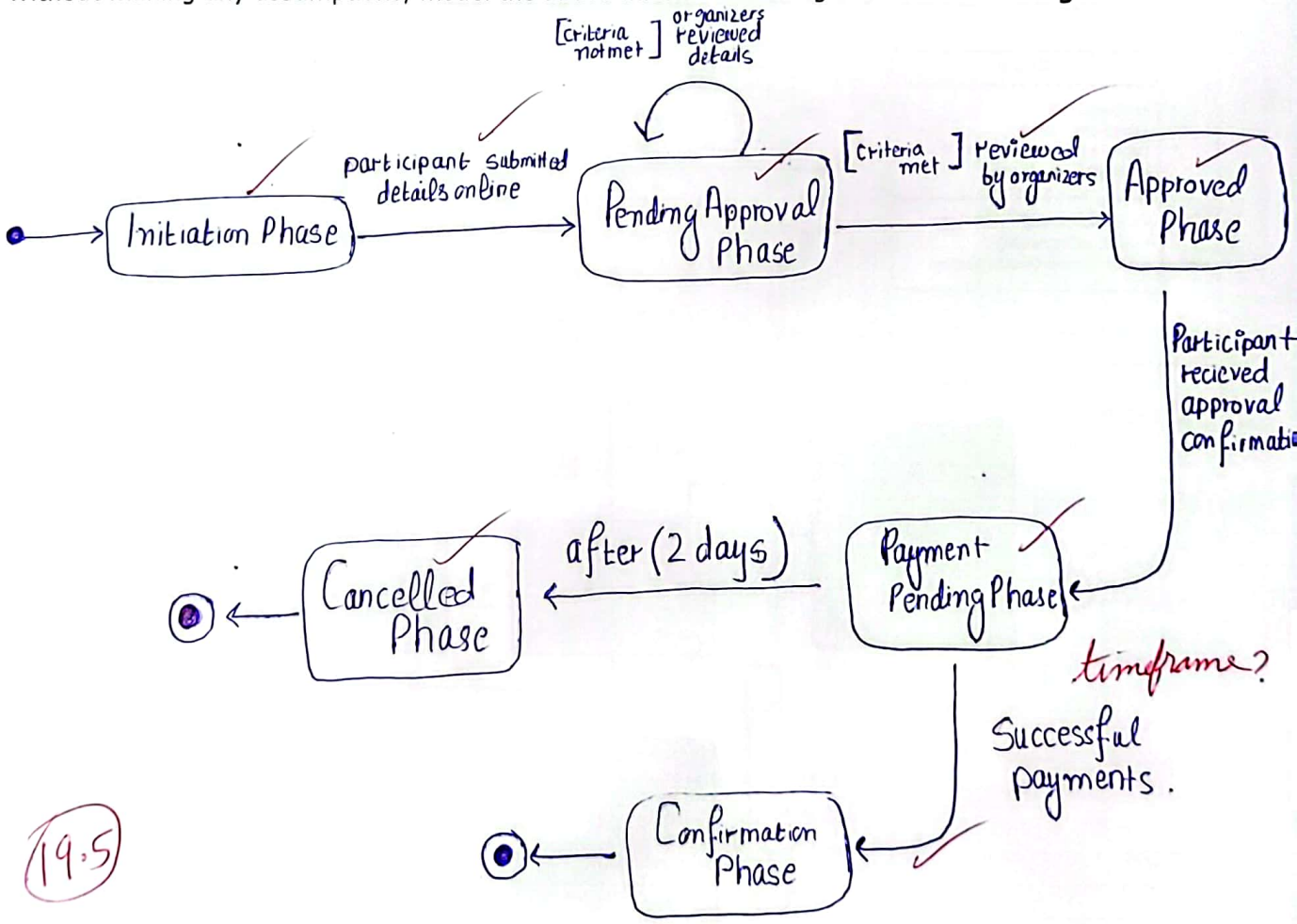
Question 3 (Max. Marks = 20) [CLO 3]

The Sports Event Registration System (SERS) is designed to revolutionize the process of participant registration for sports events, eliminating complexities and ensuring a seamless experience for both organizers and participants. The state diagram for a participant's registration provides a comprehensive visual representation of the registration phases from initiation to event confirmation.

The first phase of registration is the initiation phase. Once a participant has submitted his/her details through an online form, registration enters the pending approval phase allowing organizers to review the submitted information. If the criteria are met, registration moves to the approved phase. Otherwise, it remains in the pending approval phase. In the approved phase, after the participant has received approval confirmation, registration proceeds to the payment pending phase. Here, the participant is given a specified timeframe of 2 days to make the payment. If payment is not made within this period, registration transitions to the cancelled phase and the process ends. Successful payment made within the specified timeframe transitions registration to the confirmation phase indicating that the participant is officially registered and the process is complete.

Without making any assumptions, model the above information using a UML 2 **state diagram**.



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Question 4 (Max. Marks = 2 x 10 = 20) [CLO 5]

Design A

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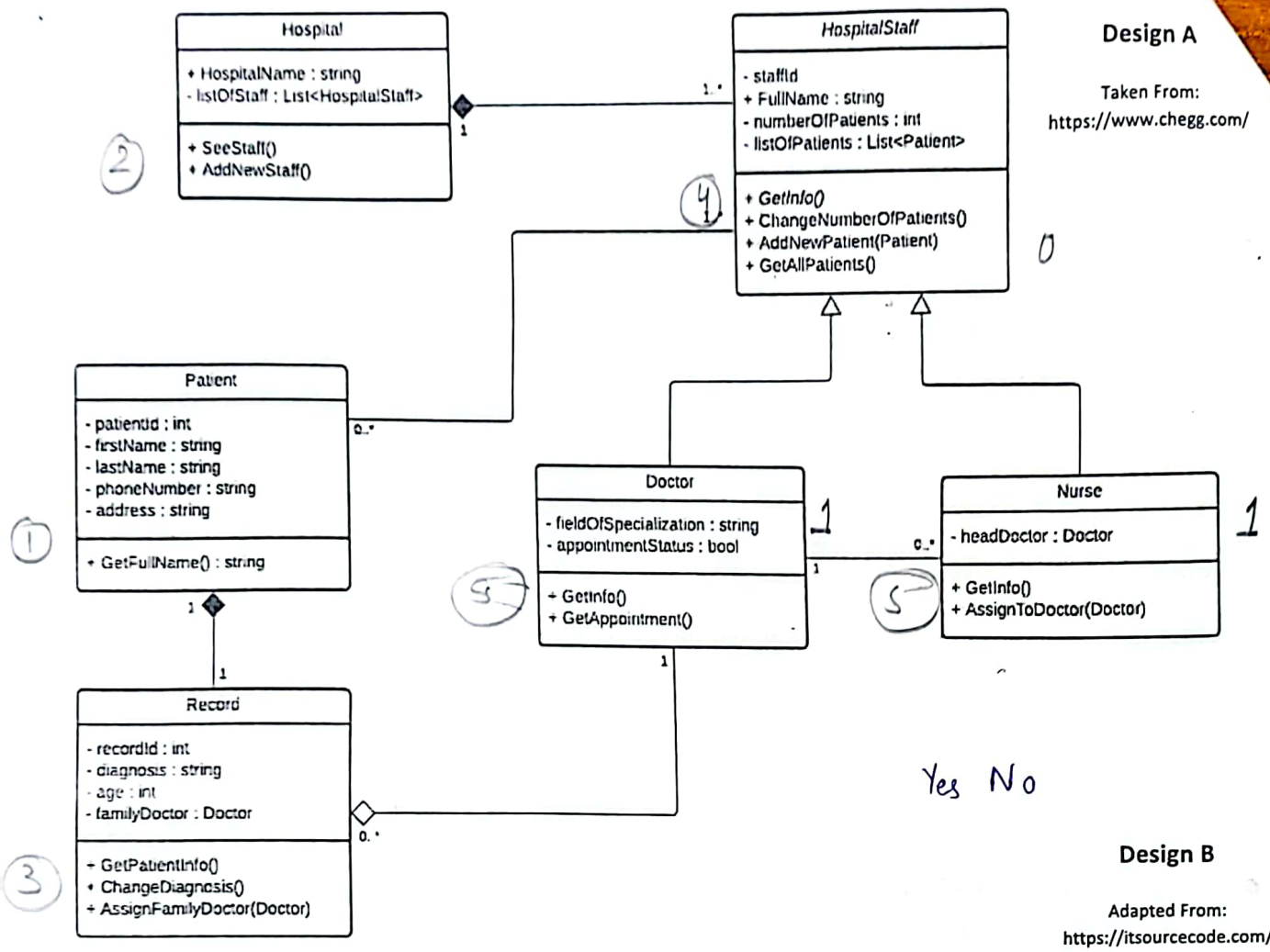
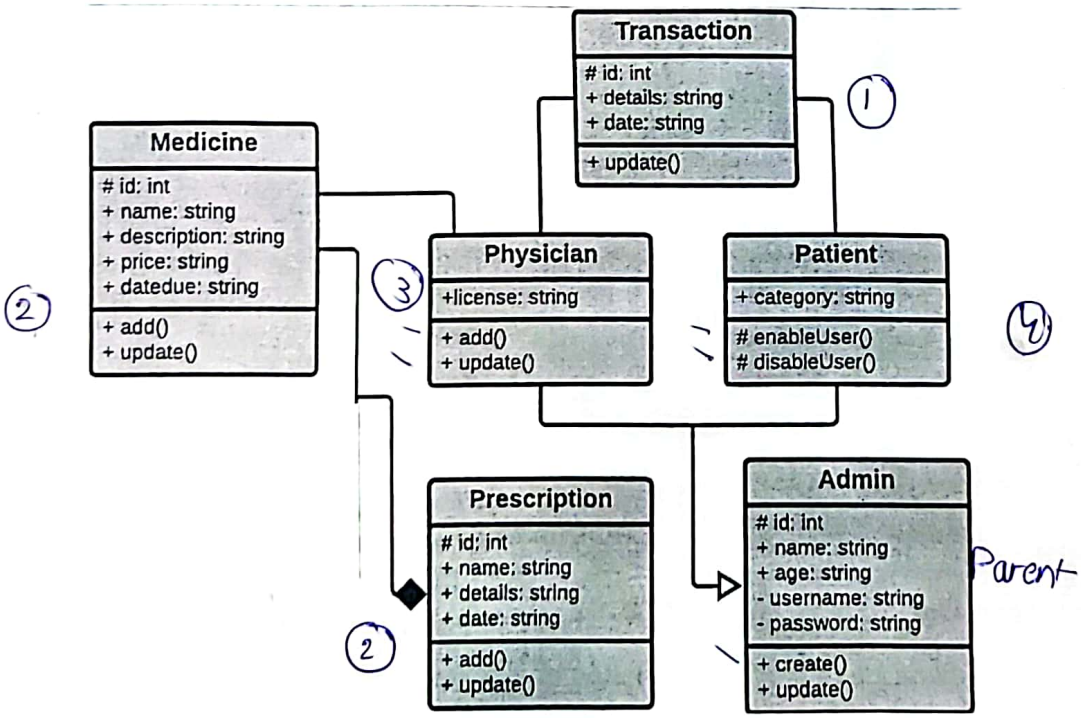
https://www.chegg.com/



Yes No

Design B

Adapted From:
https://itsourcecode.com/



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diagrams above show 2 alternative designs (A and B) of a hospital management system. Calculate the lues of the metrics given in the table below (round up to 2 decimal places) for both designs. Show working.

S#	Metric	Design A	Design B
1	Maximum Depth of Inheritance Tree	Parent : HospitalStaff Depth = 0 Child : Doctor, Nurse Depth = 1 Maximum Depth = 1	Parent: Admin Depth = 0 Child : physician, patient Depth = 1 Maximum Depth = 1
2	Minimum **Possible** Lack of Cohesion of Methods	0.	0
3	Average Weighted Methods per Class	Class | # of methods Hospital 2 Patient 1 Record 3 Hospital Staff 4 Doctor 5 Nurse 5 Total classes = 6 $\frac{2+1+3+4+5+5}{6}$ 3.33	Class | # of methods Medicine 2 Transacti 1 Physician 3 Patient 4 Admin 2 Prescriptio 2 $\frac{2+1+3+4+2+2}{6}$ 2.33
4	Average Number of Children	Parent Class: HospitalStaff 2 children : Doctor, Nurse other 5 classes have zero children $\frac{0+0+0+0+0+2}{6} = 0.333$	Parent: Admin Children : Patient, Physician (2) total classes 6 other 5 classes have 0 children $\frac{0+0+0+0+0+2}{6} = 0.333$
5	Average Coupling Between Objects	Class | CBO Hospital 1 Patient 2 Record 2 Hospital Staff 4 Doctor 3 Nurse 2 $\frac{1+2+2+4+3+2}{6}$ $14/6 = 2.33$	Class | CBO Medicine 2 Transactim 2 Physician 3 Patient 2 Admin 2 Prescription 1 Total Classes = 6 $\frac{2+2+3+2+2+1}{6}$ $\frac{12}{6} = 2$

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Question 5 (Max. Marks = 20 = 10 + 5 + 5) [CLO 2]

a. Improve the following code using an appropriate **design pattern**:

```
// Heros: captain america, he-man and thor
Weapon* createWeapon(Hero* her) {
      switch(her->who()) {
            case CAP: return new Shield();
            case HE: return new Sword();
            case Thor: return new Hammer();
      }
}
```

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Design Pattern Used: Factory. Method.

```
Class factoryClass {
    virtual weapon* createWeapon( ) = 0;
};
Class Captain America : public factoryClass {
public:
    weapon* createWeapon ( ) overide {
        return new shield();
    }
};
Class heMan : public factoryClass {
public:
    weapon * createWeapon ( ) overide {
        return new Sword ( );
    }
};
Class thor : public factorClass {
public:
    weapon* createWeapon ( ) overide {
        return new Hammer ( );
    }
};
```

// Child classes of weapon class.

```
Class weapon {
public:
  weapon ( ) { }.
};
class Hammer : public Weapon {
  // code
};
class Sheild : public Weapon {
  // code
};
class Sword : public Weapon {
  // code.
};
```

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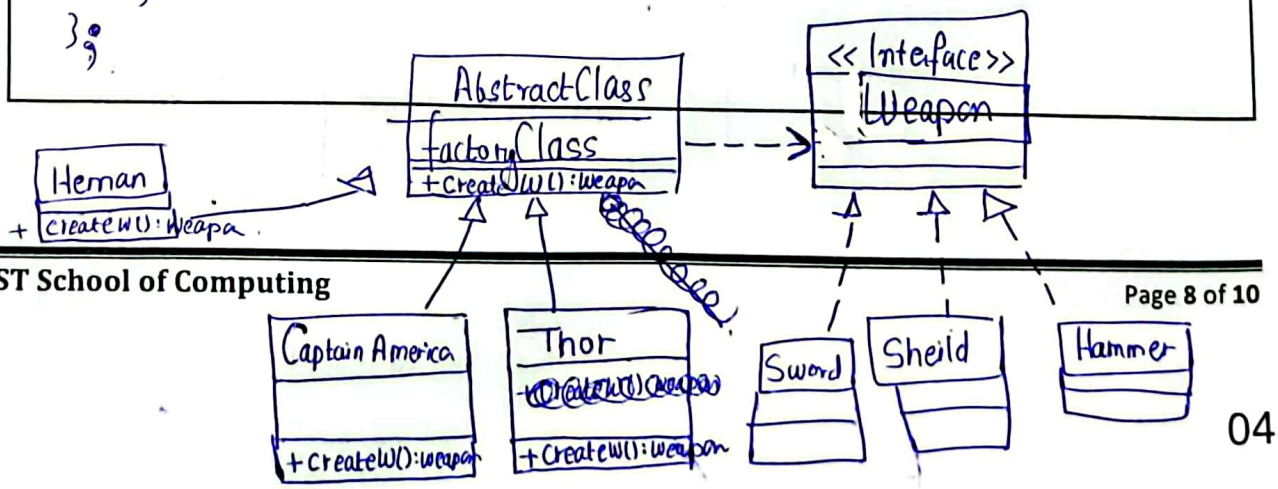

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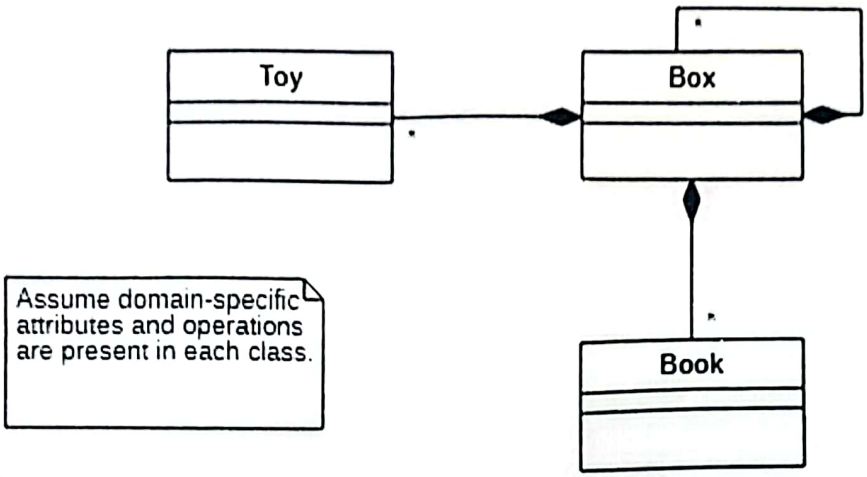
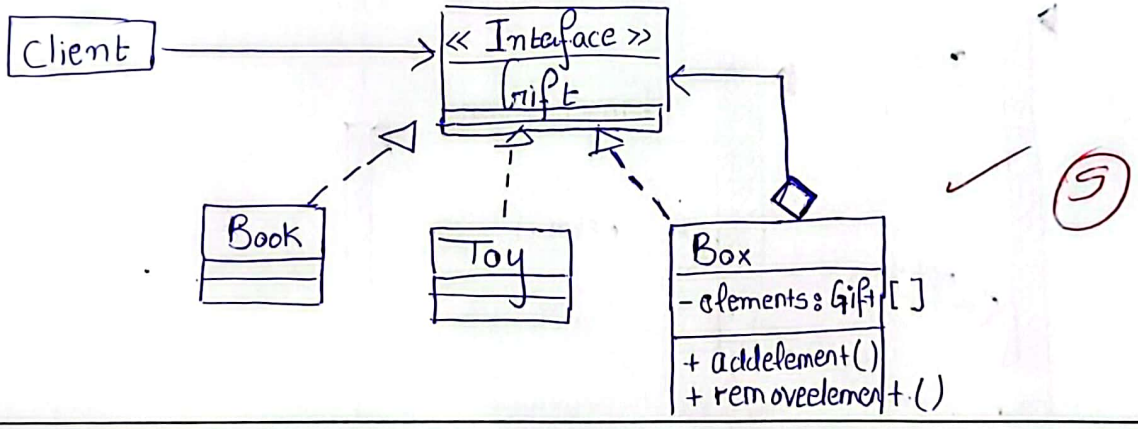
Improve the following design using an appropriate **design pattern**:
Note: All three classes represent gifts sold by a gift shop.



Design Pattern Used: Composite Design Pattern.



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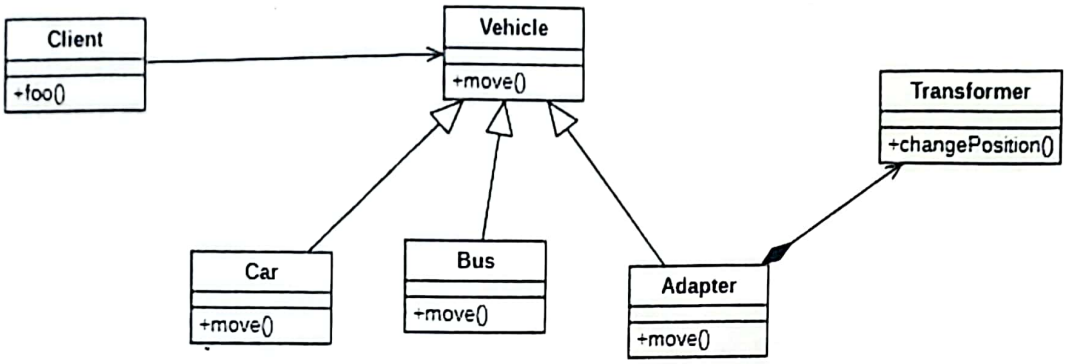
- array of interface type objects in CompositeClass

c. Consider the following (design) class diagram.



Give a (design) sequence diagram showing the following scenario:
The foo() function of a Client object calls the move() function of an Adapter object which in turn ca
changePosition() function of a Transformer object.