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**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**  
**Department of Computer Science and Engineering (CSE)**

SEMESTER FINAL EXAMINATION  
 DURATION: 3 HOURS

WINTER SEMESTER, 2022-2023  
 FULL MARKS: 100

**SWE 4501: Design Patterns**

**Programmable calculators are not allowed. Do not write anything on the question paper.**  
 Answer all 6 (six) questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

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- |    |  |                         |
|----|--|-------------------------|
| 1. | a) Define Design pattern and Design Principle. Briefly discuss the advantages and disadvantages of using Composition over Inheritance.   | 2 + 3<br>(CO1)<br>(PO1) |
|    | b) Which design pattern will you use for each of the following cases: <ol style="list-style-type: none"> <li>i. Be able to replace the implementation of an interface at run time.</li> <li>ii. Decouple clients of a system X from dependencies on subsystems of X.</li> <li>iii. Provide clients with a reference to an object of type X but defer the creation of an expensive object of type X until it is needed.</li> <li>iv. Define a new operation without changing the classes of the elements on which it operates.</li> </ol>   | 2 x 4<br>(CO4)<br>(PO2) |
|    | c) Which design pattern restores a state of an object to a previous state? Write a code example of restoring a previous state of an object.  | 2 + 6<br>(CO4)<br>(PO1) |
| 2. | a) What are the differences between the Builder and Composite pattern?   | 4<br>(CO3)<br>(PO1)     |
|    | b) A popular online bookstore platform that caters to readers worldwide. A customer places an order for historical novels on the bookstore platform. The order is passed through a chain of responsibility, consisting of distinct handlers for validation, discount application, payment processing, and shipping respectively. The order moves seamlessly through each handler in the chain. If at any stage the order fails validation or encounters an issue, the processing is halted, ensuring a smooth and error-resistant order fulfillment process.<br>Which design pattern can you use to implement the scenario? Write the corresponding code to implement the scenario using that appropriate pattern. | 1 + 5<br>(CO4)<br>(PO2) |
|    | c) Explain low coupling and high cohesion with examples.   | 5<br>(CO1)<br>(PO1)     |
| 3. | a) An application contains an interface <code>Shape</code> which is implemented by two concrete shapes namely <code>Circle</code> and <code>Rectangle</code> . Several composite shapes can be created by using these two concrete shapes. Composite shapes can be visited by a visitor from the outside of the application with the help of a <code>ShapeVisitor</code> interface.<br>Write code for the above-mentioned scenario using appropriate pattern and draw the corresponding UML diagram.   | 6 + 5<br>(CO4)<br>(PO2) |

- b) Consider a class that is used to create Cake. It needs a number of items like egg, milk, and flour to create cake. Many of those items are mandatory and some are optional like cherries, fruits etc. If we are going to have overloaded constructor for a different kind of cake, then there will be many constructors and even worse they will accept many parameters. Identify a pattern that can solve this problem. Write the corresponding implementation of your chosen pattern. 2 + 5  
(CO4)  
(PO2)
4. a) Use Composite Pattern to model the notion of a folder in Windows XP. Folders may be nested and may also contain text files and binary files. Files may be opened, closed, or drawn on the screen. Folders may also have items added and removed from them. Draw the UML diagram for the described model. 6  
(CO3)  
(PO1)
- b) Perform a comparative analysis among Singleton, Prototype, and Flyweight design pattern. 6  
(CO3)  
(PO1)
5. a) Consider the Code Snippets 1 and 2: 3 x 5  
(CO2)  
(PO2)

```
1 public class Rental {
2     private Movie _movie;
3     private int _daysRented;
4     public Rental (Movie movie, int daysRented) {
5         _movie = movie;
6         _daysRented = daysRented
7     }
8     public int getDaysRented() {
9         return _daysRented;
10    }
11    public Movie getMovie() {
12        return _movie;
13    }
14    public double amountFor() {
15        double thisAmount = 0;
16        //determine amounts for each line
17        switch (getMovie().getPriceCode()) {
18            case Movie.REGULAR:
19                thisAmount += 2;
20                if (getDaysRented() > 2)
21                    thisAmount += (getDaysRented() - 2) * 1.5;
22                break;
23            case Movie.NEW_RELEASE:
24                thisAmount += getDaysRented() * 3;
25                break;
26            case Movie.CHILDRENS:
27                thisAmount += 1.5;
28                if (getDaysRented() > 3)
29                    thisAmount += (getDaysRented() - 3) * 1.5;
30                break;
31        }
32        return this.Amount;
33    }
34 }
```

Code Snippet 1: Code Snippet for Question 5.a)

```

1 public class Movie {
2     public static final int CHILDRENS = 2;
3     public static final int REGULAR= 0;
4     public static final int NEW_RELEASE = 1;
5
6     private String _title;
7     private int _priceCode
8
9     public Movie (String title, int priceCode) {
10         _title = title;
11         _priceCode = priceCode;
12     }
13     public int getPriceCode() {
14         return _priceCode;
15     }
16     public void setPriceCode(int arg) {
17         _priceCode = arg;
18     }
19     public String getTitle {
20         return _title;
21     }
22 }

```

**Code Snippet 2:** Code Snippet for Question 5.a)

Answer the following questing according to Code Snippet 1 and 2.

- i. Briefly explain the terms "Code refactoring" and "Code smell".
  - ii. Identify two code smells which have occurred in the code.
  - iii. Refactor the code removing the smells.
- b) Write short notes on *Refused Bequest* and *Large Class*. 4  
(CO2)  
(PO1)
6. a) Draw a UML diagram for Mediator Pattern between web services and web clients. As web services, the eBay auction house and Amazon are available. Propose function to search for an item given a text description, and to buy an item from the service that gives you the best price. 5  
(CO4)  
(PO2)
- b) Which two design patterns which reduce memory footprint. Perform a comparative analysis between them. 1 + 4  
(CO4)  
(PO2)
- c) Identify a pattern that decouples an abstraction from its implementation so that the two can vary independently. Explain a scenario satisfying the statement. 1 + 4  
(CO4)  
(PO2)