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

MID SEMESTER EXAMINATION **WINTER SEMESTER, 2022-2023**
DURATION: 1 HOUR 30 MINUTES **FULL MARKS: 75**

SWE 4301: Object Oriented Concepts II

Programmable calculators are not allowed. Do not write anything on the question paper.
Answer **all 3 (three)** 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) "Violation of LSP is a latent violation of OCP" - considering SOLID principles, explain the statement with an appropriate code example. 8 (CO1) (PO1)

   b) How do Object-Oriented Concepts (OOC), the SOLID principles, and Test-Driven Development (TDD) relate to each other in the context of software development? Illustrate their interconnections and dependencies with a diagram. 10 (CO1) (PO1)

   c) A common principle in Object-Oriented Concepts is "prefer composition over inheritance". How do you choose one over another? Justify your preference with an example. 7 (CO1) (PO1)

2. a) Consider `Customer` and `PaymentProcessor`, two concrete classes where `Cutomer` uses `PaymentProcessor`. 5 (CO3) (PO3)

```
1 public class Customer{
2     private PaymentProcessor paymentProcessor;
3     public Customer(){
4         paymentProcessor = new PaymentProcessor();
5 }
```

Code Snippet 1: A portion of the class `Customer` for Question 2.a)

What problem(s) do you find from the design perspective between the class `Customer` and `PaymentProcessor`? How would you rewrite the code to achieve less coupling?

   b) Briefly explain each of the following code smells with an example: 3 × 3 (CO1) (PO1)
      i. Feature Envy
      ii. Shotgun Surgery
      iii. Primitive Obsession

   c) Explain the "Incomprehensibly Concise" and the "Shameless Green" approaches to implement a requirement. Which one is considered better practice? Justify your choice. 6 (CO1) (PO1)

3. CodeForFuture Solution Ltd. is assigned to build a software for a super shop. The shop has different products. For example food, electronics, and stationary. The software will be able to calculate product discounts, Value Added Tax (VAT), and validity of products based on product types. Discounts of a product can be calculated from the offered price and the number of days the product is stored in the shop. Whether a product is expired or not is calculated based on days. Lastly, different products have different VAT associated with them. Code Snippet 2 represents the existing implementation to satisfy those requirements. You can assume that the program has no compile time error.

```
1  public enum ProductType{
2      Food, Electronics, Stationary
3  }
4  public class Product{
5      public ProductType type { get; set; }
6      public Product(ProductType type){
7          this.type = type;
8      }
9      public int CalculateDiscountedPrice(int op, int age){
10         if (type == ProductType.Food)
11             return op - op * age / 10;
12         else if(type == ProductType.Electronics)
13             return op - Math.Min(op / 5, 100);
14         else
15             return op - 5;
16     }
17     public bool IsExpired(int a){
18         if(type == ProductType.Food)
19             return a > 5;
20         else if (type == ProductType.Stationary)
21             return false;
22         else
23             return a > 365;
24     }
25     public double CalculateVAT(){
26         switch (type)
27         {
28             case ProductType.Food:
29                 return 0.025;
30             case ProductType.Electronics:
31                 return 0.04;
32             default:
33                 return 0.05;
34         }
35     }
36 }
```

Code Snippet 2: A C# program for Question 3.

a) The program has several code smells. Identify at least 5 unique code smells and specify the line number(s). Also, mention the reasons for the code smells. — 10 (CO2) (PO1)

b) What are design smells? Relate the code smells of Code Snippet 2 with relevant design smells. — 5 (CO1) (PO1)

c) Refactor the program in Code Snippet 2 to satisfy SOLID principles by removing code smells. You can use a Class Diagram or your preferred OOP language. — 10 (CO3) (PO3)

d) Why do you need the Factory Method pattern to refactor the program's code smells? Write a test case and Factory Method pattern code in your preferred OOP language. — 2 + 3 (CO2) (PO1)