University of Ruhuna - Faculty of Technology
Bachelor of Information & Communication Technology Honours Degree
Level 2 (Semester I) Examination, June/July 2023
Academic year 2021/2022

Course Unit: ICT2142 Object Oriented Analysis and Design (Theory) Duration: 2 hours

Answer all four (04) questions.
....

1.

    a. Object orientation is about viewing and modeling any system as a set of interacting and interrelated objects.
    Write down four (04) advantages of object orientation.

                                                     [12 marks]

    b. Using three (03) key points, compare object-oriented programming and procedural programming.

                                                     [12 marks]

    c. An object is a real-world entity. Briefly describe an object's attributes and methods using suitable examples.

                                                     [12 marks]

    d. Specify the role of following terms by giving suitable examples.
        i. Object Oriented Analysis
        ii. Object Oriented Design

                                                     [12 marks]

    e. Encapsulation is a fundamental concept in object-oriented programming.
        i. Define 'Encapsulation'.
        ii. Provide a real-world example for the use of Encapsulation.
        iii. State two (02) advantages of using Encapsulation.

                                                     [14 marks]

    f. The following scenario is narrated for an online item ordering system.

    The customer initiates the use case by login to his/her account by giving the user id and password to order items/products that he/she wants. Customer can select items based on the name of the item. Prices of each item is maintained as a separate object. Customers get the price of each item when ordering. Once the ordering is finished, the customer makes payment. Payment can be made either using Master Card or the Visa card.

    Draw the Communication Diagram for the above given scenario.

                                                     [38 marks]

2. Answer the questions based on the case study given below.

An on-line shopping mall requires the implementation of shopping cart functionality. The following is a description of the requirements.

Users should be able to browse items online and add them to the shopping cart. There needs to be the possibility to view browsed items where a more detailed description of the product is shown.

Even an unregistered user can add items to the shopping cart and proceed to check out the items (complete transaction), but the user needs to be authenticated by the system and therefore registration is mandatory at this point. To register, the users need to provide a unique login-id, First Name and Last Name, valid e-mail address and a password and thereby an account is created for the user. It is essential to ensure that the password passes the required strength test. A 'new' user will be created in the system and an e-mail will be sent to the given e-mail address with a system generated verification code and the new user needs to enter that verification code into the system to activate his account. User information together with registration information should be maintained in the system. System will make a user account 'Suspended' temporarily for one hour upon three login failures and after one hour the user account is automatically made 'Active'. If a particular user has not performed any activity on the web site for one year, then that users' account will be suspended by the system too. In both cases the users have the facility to resume the suspended account by following the instructions provided and make the user account 'Active'. A user account may be 'Banned' upon any illegal activity.

Registered users will be able to log-in to the system and based on their browsing history, system needs to be able to provide them with a list of recommended products by way of a link called 'View Recommended Items'. Pre-requisite for this is that the user is successfully authenticated. At the time of registration, users can add their billing address and one or more shipping addresses to the system. The billing address must match with the credit card billing address if they plan to purchase the items via credit card.

Details of products need to be maintained and each product can belong to one or more product categories such as 'Electronics', 'Computer Peripherals', 'Electrical Appliances' etc. The current sale price of the product is also maintained.

A user will have one shopping cart per browser session and all the items added to the cart in that session will be associated with the cart. It should be possible to edit/delete the added items. When a user proceeds to check-out, existing users need to log in (if not already logged-on) or new users need to register as mentioned before. The system will calculate the total amount based on the cart items. Tax and shipping costs also will be added to the total amount. Payment information needs to be entered into the system where the user has the option of paying by either credit card or using 'PayPal'. Shipping address needs to be entered as well. It would be easier for the users if they have maintained their billing and shipping addresses in the system and there should be provision for easy retrieval of this information. The system should provide the facility to add/edit address information for

registered users as well. A 'preliminary' order is created and upon verification of the payment information, the order is 'confirmed'. All items checked-out are included in the order and a copy of the order is e-mailed to the user's e-mail address. An order knows when the order has been 'shipped' and when the items are 'delivered' to the user. When the order is shipped the user needs to be notified via e-mail.

a. Identify the actor(s) in the above system.

[08 marks]

b. Consider the following description about the checkout scenario.

In checking out, first the user needs to be logged on to the system (Authenticated). If not, the user should be prompted to log on or register with the system. The user has the option of viewing and updating the shopping cart and accordingly the total amount need to be re-calculated. Next, the shipping cost and the amount of applicable taxes need to be calculated. The payment method needs to be specified and depending on that, the external actors Credit Card Payment Service or Paypal Payment service will verify the payment details.

Draw the use case diagram for the Checkout scenario showing the relationships.

[40 marks]

c. Users can view items to see a more detailed description of an item. They can view an item by browsing. Part of the use case diagram relevant to browse and view an item is given below.
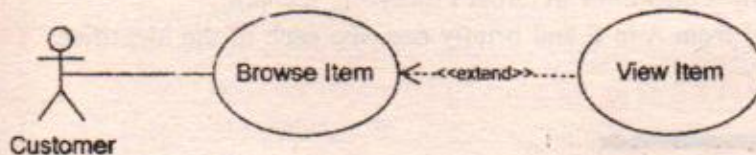
If the users can view an item by browsing or searching for a particular item, show that requirement by modifying the part of the use case diagram given above. Indicate correct relations.

[07 marks]

d. Identify the object(s) in the system that can be in different states during its lifetime and name the states for each identified object.

[13 marks]

e. For the following subset of identified classes draw Relationships and indicate Multiplicity.
Classes: Product_Category, Product, Order, Order_Item, Account, Address
(Note: Attributes and methods of classes are not required to be included)

[26 marks]

f. Which of the classes have generalization relationships?

[06 marks]

3.

a. There are mainly three types of use case formats named as brief, casual and fully dressed.
   i. Briefly describe what a use case is.

   ii. Construct a use case in fully dressed format for the following description of an online books purchasing system.
   (Note: You should only include the use case name, primary actor, pre-condition, main success scenario, and extensions sections in your fully dressed format use case).

   Using the online books purchasing system users can search for books online. First the user logs into the system. If the login is successful, then he/she can enter the book name/author name or ISBN number and click the search button. Otherwise, the system will display the login page again. If the search is successful, then the book details are displayed on the screen. Otherwise, if the searching parameters are wrong, the system will display the error message "Please enter valid details", else if the book is not available in the system the message "No search results to show" will be displayed.
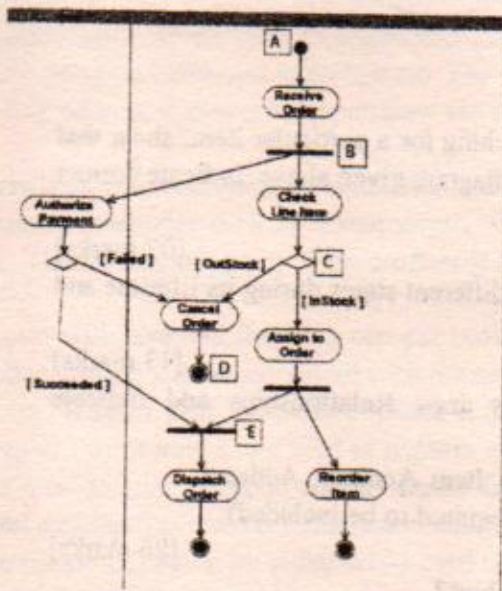
   [21 marks]

b. Actions are the elemental unit of behavior in an activity diagram.
   List down the three (03) main features of actions and briefly explain each feature in your own words.

   [21 marks]

c. The following activity diagram is drawn for an Order Processing scenario.
   Identify the elements labelled from A to E and briefly describe each of the identified elements.

   [25 marks]

d. Draw the corresponding activity diagram for the following use case narration, "Farmer Registration".

Use Case Name	Farmer Registration
Goal in context	This use case describes the event of registering the farmers with a mobile based agriculture information system using their National Identify Card (NIC) numbers, names and mobile phone numbers.
Primary Actor	Farmer
Pre-conditions	Farmer should open the application and the user home page is being displayed.
Post-conditions	Farmer has been registered and Farm registration page of the system is displayed.
Triggers	This use case begins when farmer clicks on the "Registration" icon or link on the Home page of the application.

Typical Course of Events	
Step	Action
1	The Farmer clicks on the registration icon or link.
2	The system responds by displaying the farmer registration page of the application.
3	Farmer enters his NIC, name and the mobile phone number and clicks the [OK] button.
4	The system validates the entered fields
5	The system sends a PIN number to validate the phone number.
6	Farmer enter the received PIN and click on [NEXT] button.
7	The system displays the "Farm registration" page
Alternative Courses	
4	If the farmer leaves any field empty, the system pop-ups an error message and direct user to step 3.

[33 marks]

4.

a. State the two (02) types of responsibilities of responsibility-driven design (RDD). Briefly explain each.

[16 marks]

b. Briefly explain how object orientation uses the two (02) concepts called cohesion and coupling.

[10 marks]

c. Clearly state whether each of the following statements is **true** or **false**.
   i. A Use Case diagram identifies all the actors, use cases and their relationships.
   ii. In class diagrams, Composition in a relationship is represented by a hollow diamond and a line between classes.

iii. A sequence diagram is an interaction diagram which focuses on the message interchange between a number of lifelines.

iv. Information Expert is not a General Responsibility Assignment Software Pattern (GRASP).

v. In Object Orientation, breaking up a complex system into manageable components is called abstraction.

[15 marks]

d. Consider the following scenario and draw a sequence diagram.

To give an exam, an instructor first notifies the students of the exam date and the material to be covered. She then prepares the exam paper, gets it copied by non-academic staff to produce enough copies for the class, and hands it out to students at the designated time and location. The students write their answers to exam questions and hand in their papers to the instructor. The instructor then gives the exam papers to the TAs, along with sample solutions to each question, and gets them to mark it. The instructor then records all marks and informs the marks to the students.

[59 marks]

--------- End of the Paper ---------