

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Object Oriented Analysis and Design (CT651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. What are advantages of object oriented system over procedural system? Explain association, aggregation and composition relationships with suitable examples. [2+6]
2. What is operation contract? Construct a System Sequence Diagram (SSD) for online examination system with necessary assumptions. [2+6]
3. How can you express exceptions in UML diagrams? Illustrate with possible exceptions in any suitable scenario. [6]
4. For the case study given below identify all classes, their relationships, attributes and methods for each class. Also draw class diagram using standard UML Notation. [8]

Makalu College operates international business in 10 location throughout the globe. The college has its first 9000 graduates in 2010. The second keeps track of each student's name, country of birth, current address. In order to maintain strong ties to its alumni, the school holds various events around the world. Events have title, date, location and time. The school needs to keep track of which graduates have attended which events. For an attendance by a graduate at an event, a comment is recorded about information. School officials learn from that graduate at that event. As with the events, school records information learned from graduates. When an official knows that he or she will be meeting or talking to graduate, a report is produced showing the latest information about the graduate and the information learned during the past two years from that graduate from all contacts and events the graduate attended.

5. Describe the term Design pattern? Explain the purpose and benefits of information Expert, Creator, Controller and Polymorphism design patterns defined by GRASP. [1+6]
6. a) Describe the term OOP, code refactoring. [2]
 - b) For the class diagram created in Question number 4 apply object oriented techniques to converts such class diagram into implementation code in any of your favorite object oriented programming language. Your implementation code should clearly show class definition, attributes with their proper visibility and method signatures with required parameter. [7]

7. The famous digital eatery at Durbar Marge, "Naulo Restaurant", which is designed by IOE graduate engineers, processes everything either through Robot or with digital device, except food preparation and cooking. Every tables-tops is equipped with large tablet screen and using the table each customers selects the food items they would like to order. Once the customers selects the items, the restaurant system automatically dispatches the food items selected as the order to the kitchen unit of the restaurant. Again, when the food item is prepared, the robot named "Ginger" will get called in by kitchen unit for delivering the food item to the particular table number through system. The food plate, once being loaded onto the tray of Ginger, which delivers the food up to the customer table and then system get updated as the order is delivered and due bill is generated for the food item of that table. This process might be repeated for multiple times as the additional food ordering and serving might happen frequently. Finally, the customer pays accumulated bill either swiping the credit/debit card or through online payment. Order taking process, order dispatching process, food delivery and paper bill carrying up to the table through humans are eliminated so, they claimed it as complete digital restaurant. Now answer the followings:

[6×3]

- i) Prepare the USE case diagram of the system.
- ii) Prepare activity diagram of the system.
- iii) Prepare the sequence diagram of the system.

8. Compare the followings:

[4×4]

- i) Conceptual model vs. Implementation model
- ii) Forward Engineering vs. Reverse Engineering
- iii) Association types vs. Cardinality constraints
- iv) Design pattern vs. Components reuse

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1. a) What are the main differences of OO based design cycle to other conventional design cycle? Explain with relevant example. [6]
 b) Describe functional and nonfunctional requirements with suitable examples. [3+3]
2. What are the strengths of the agile development method? Explain how the requirement elicitation process happens in OOA. [2+4]
3. Define conceptual class and domain model. Explain primary relationship between class, dependency, association, aggregation and composition with their corresponding notation. [8]
4. Draw the sequence diagram of login page. Use four scenario as following: User, User Interface, Login-Session (active or expire) and System validity. Show all scenarios with brief explanation. [6]
5. The model depicts the online order processing system as illustrated in figure 1. Explain in detail of the diagram type with every symbols being used and semantics of this diagram. [8]

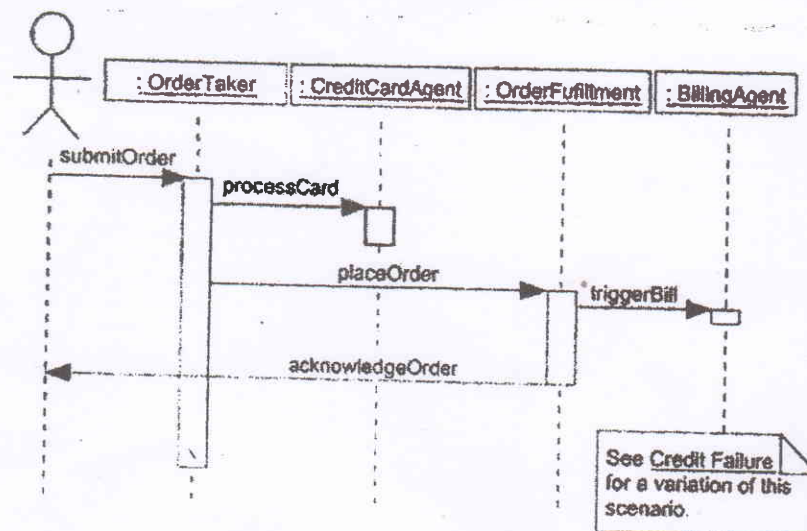


fig.1

6. State-sequence diagram aids the implementation of Reactive system. If you agree on the statement, justify with reason and model diagram. [6]
7. Discuss the mechanism of transformation from OOA to OOD? Prepare the Activity diagram for restaurant booking system. [4+4]

8. Draw a complete Use case Diagram and domain Model with proper UML notation for the following case study.

[10]

A university registrar's maintains data about the following entities: Courses, including number, title, credits, syllabus and prerequisites; Course offerings, including course number, year, semester, section number, instructor (s), timing and classrooms; Students, including student id, name, and program; and instructors, including identification number, name, department, and title. Further the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled.

9. Prepare an activity diagram for computing a restaurant bill. There should be a charge for each delivered item. The total amount should be subject to tax. There is a service charge of 18% for groups of six or more and 10% for smaller groups. Any coupons and gift certificates submitted by the customer should be subtracted.

[8]

10. Write short notes:

[4x2]

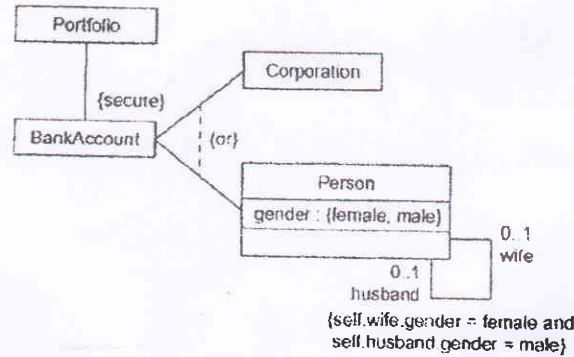
- a) Design Patterns and its use in OOAD
- b) Distributed system implementation issues

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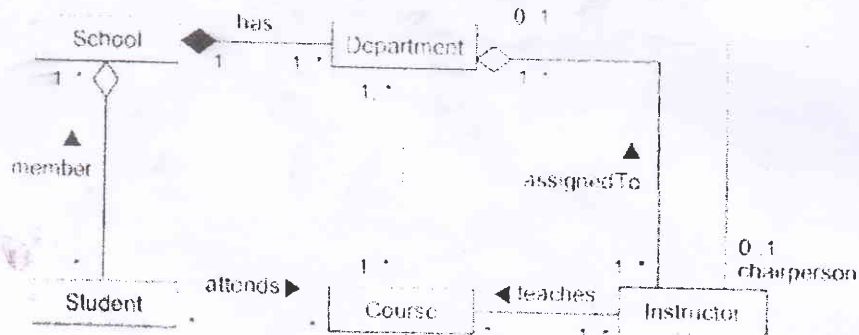
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1. a) What are the meaning of Object and Encapsulation in terms of OOAD? Explain briefly with example. [6]
- b) Prepare the fully labeled use cases for cash withdraw case of the banking system. [6]
2. IN OOAD, there are various types of models, like conceptual, structural, behavioral, etc. What is the significance of these many different types of model? Explain with illustrative examples. [6]
3. What is the role of constraint specifications in a model diagram? The model below figure depicts about possible types of accounts within the portfolio sub-head in any banking business domain. Identify the constraints highlighted and explain brief, what they mean. Write pseudocode the model diagram. [8]



4. What are the perceptions of applying UML? Consider the Library System. Each book in a library contains bibliography, each bibliography consists of a number of reference to other books. A book will be referred to in many cases and therefore a reference can appear in more than one bibliography. Use noun phrase identification strategies to find the conceptual classes of above cases. [2+4]
5. Present the mapping process for the figure below model using object-oriented based pseudo-codes for capturing all important aspects of the model diagram. [10]



6. Prepare a comparative note on forward versus reverse engineering with mentioning the merits, demerits and implementation challenges. [6]

7. What is the purpose of CRC? Illustrates the concepts of coupling and cohesion in object oriented design with suitable example. [2+3]

8. What are pattern based design and its benefits? Prepare illustrative notes on pattern based design. [6]

9. Identify conceptual class and its supportive attributes for a Photocopier machine from the description given below and draw the conceptual class diagram for the same. Initially the machine is off. When the operator switches on the machine, it first warms up during which it performs some internal tests. Once the tests are over, machine is ready for making copies. When operator loads a page to be photocopied and press 'start' button, machine starts making copies according to the number of copies selected. When machine is making copies, machine may go out of paper. Once operator loads sufficient pages, it can start making copies again. During the photocopy process, if paper jam occurs in the machine, operator may need to clean the path by removing the jammed paper to make the machine ready. [9]

10. Write short notes on: [4×3]

- a) Agile method
- b) Association visibility
- c) Dewey Decimal Numbering and its use in modeling
- d) design Patterns and its use in OOAD

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1. a) What do you mean by Unified process (UP) in OOAD? Explain the phases with suitable diagrams. [3+3]
- b) Consider the scenario of flight booking through an online system at first and then with allowance of certain days of delay for final purchase through second round of payment process completion. Identify all the actors, use-cases and relationship. Also draw use case diagram. [8]
2. a) How does static and dynamic analysis differ in OOAD? Explain in brief. [5]
- b) Draw class diagram and activity diagram with object flow depiction on the following scenario operating condition system:

Patient can arrange and cancel appointment with physician using scheduler. Physician succeeded to prescribe Medication for patient. Physician specifies Drug Info: Medication name, Dosage amount, Number dosages and Refills. Computer cross checks for conflict between Medication and current Medications/Medicinals history prescription forwarded electronically to Pharmacy and printed for patient as well. [5+5]
3. a) In what aspects the sequence diagram is different from collaboration diagram? Prepare the sequence diagram of the bus ticket reservation system. [2+6]
- b) Explain the concepts of Controller and Polymorphism as per the definition outlined from GRASP design pattern with illustration. [8]
4. a) With the help of suitable examples, explain how you can handle errors and exception in object oriented system implementation. [6]
- b) How can we create class definition and methods from the domain class diagram and interaction diagram? Explain with appropriate example. [4+4]
5. Write short notes on: [3×4]
 - i) CRC cards
 - ii) MVC pattern
 - iii) Swimlanes in activity diagram
 - iv) Adornment of relation
6. Compare the followings: [3×3]
 - i) Forward vs Reverse Engineering
 - ii) Forking vs Joining
 - iii) Micro vs Macro processes ooDesign

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1. a) What makes the use-case diagram as an important in UML diagrams? Illustrate your argument with a model use-case diagram for a particular scenario. [3+3]
- b) What are requirements process alternatives before having OO Analysis? As you are already familiar with IOE exam processes, prepare a brief SRS document following unified process in OOAD. [3+5]
2. a) Describe the strategies to identify conceptual classes. Describe the steps to create a Domain Model used for representing conceptual classes. [6]
- b) Consider a Rental Car System (RCS). A rental agency has multiple offices/locations where customer can test drive and select a car for rental. The period of rental, terms and conditions for rental is flexible. RCS has to take responsibility for loaning cars, keeping track of availability of cars, return of cars, billing, maintenance activities for cars and keeping track of driver's availability and assignment in case of chauffeur driver car rentals. Identify the candidate objects with relationships of above case. [8]
3. a) For the case study given below identify all classes, their relationships, attributes and methods for each class. Also draw class diagram using standard UML Notation. XYZ Marina is privately owned corporation that rents boats and provides boat services on a lake. The Corporation needs automated system to track customers, leased slips (Each space for boat in lake) and boats in the slips. The corporation has two types of boats sail boat and power boat. Both types of boats are uniquely identified by their attributes like registration number, manufacture year and boat length. The boat can be leased on daily basis or yearly basis. The system should perform following tasks creating lease, computing lease amount, assigning boats. The system should also have features of search for vacant slips leased to specific customers and generating customized reports. The system should have to implement billing system as well. [8]
- b) For the above class diagram created apply object oriented techniques to convert such class diagram into implementation code in any of your favorite object oriented programming language. Your implementation code should clearly show class definition, Attributes with their proper visibility and method signatures with required parameter. [8]
4. a) How interface differ from implementation? Explain the concept of interface and implementation in any object oriented programming languages. [6]
- b) What are the major functions of Exceptions and error handling in the programs development? Is it required to develop the program? Justify it. [3+3]
5. What is singleton class? Explain the different types of visibility in object oriented design. [2+6]
6. Write short notes on: [4×4]
 - i) Information content in forward and reverse engineering
 - ii) Data dictionary stability
 - iii) GRASP
 - iv) Types of interaction diagram and their focus

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1. a) Differentiate between functional and non-functional requirement. What are the relationships in Use Case Diagrams and explain <<include>> and <<extend>> relationships with diagram? [5]

b) For the case study given below identify all the actors, use cases and relationships also draw use case diagram. [5]

A coffee Vending Machine dispenses coffee to customers. Customers order coffee by selecting a recipe from a set of recipes. Customers pay for the coffee using coins. Change is given back if any to the customers. The Services staff loads ingredients (coffee power, milk, sugar, water and chocolate) into the coffee machine. The service staff can also add a recipe by indicating the name of the coffee, the units of coffee powder, milk, sugar, water and chocolate to be added as well as the cost of the coffee.

2. Explain all types of external actors in relation to System under Discussion (SuD). Draw a system sequence diagram for the Library Management system with the following requirements. You can add additional elements if necessary.

A college library has 4 librarians to manage and issue the books to the users who are either students or faculty staffs. The library contains the books belonging to Computer and Humanities streams. The books are course books, reference books, book banks etc. The users must log into system to search the required books and may reserve the books earlier. The librarian issues the books to the users and also charge fine in case of delayed return or loss of the book. The librarian asks for the "Sanu Publisher" to supply the necessary books into the library. The librarian manages all the users. [2+6]

3. What do you mean by Domain Modeling? Present the guidelines to add attributes and associations in the domain model. [6]

4. How can you represent the dynamic behavior of the system in Object Oriented Analysis (OOA)? Explain with example. [6]

5. Draw the class diagram and map the design into code for "Health Care Center" as following: Patient can arrange and cancel appointment with physician using scheduler. Physician secedes to prescribe Medication for patient. Physician Specifies Drug Info: Medication name, Dosage Amount, Number Doses and Refills. Computer Cross-Checks for Conflict between Medication and Current Medications/Medical History Prescription Forwarded Electronically to Pharmacy or Else Printed for Patient. [10]

6. a) In many ways, a deployment diagram is just a special kind of class diagram, which focuses on a system's nodes. Justify this statement. [5]

b) Draw an exception class hierarchy to present the errors and exceptions derived from the Throwable class. [5]

7. How pattern different from framework? Explain information Expert, Creator and Low Coupling design patterns defined by GRASP Design Pattern. [8]
8. a) Explain the concept of interface and implementation in object oriented design and implementation. [5]
- b) During object oriented implementation of design class diagram you may encounter one-to- many relationships between classes. With the help of collection and generic classes, explain how you can represent these relationships in object oriented programming. [5]
9. Compare the followings: [4×3]
- a) Forward Engineering vs. Backward Engineering
- b) Structural Model vs. Implementation Model
- c) Flowchart Vs. Structure chart

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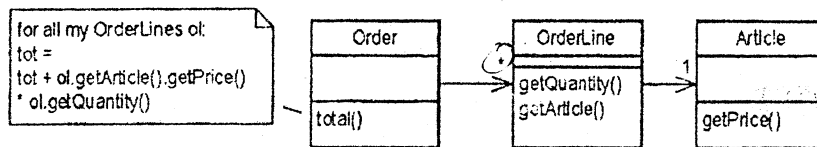
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- 1 What are the differences between algorithmic decomposition and object-oriented decomposition in the process of systems analysis for a complex system? What is the role of hierarchy, another feature of object-orientation, in such decomposition process? [6 + 4]
- 2 Explain four primary relations between classes; dependency, association, aggregation, and realization, with their corresponding notations. [8]
- 3 What is behavior modeling in object-oriented analysis? Present any four sample diagrams that are based on behavior modeling. [4 + 4]
- 4 A new bus service, Gana Rajya Express (GRE) is starting soon, which has the business plan and operation as detailed below. [10]

GRE sells tickets only through the web service, not in bus stations or in buses. Tickets must be paid by credit card or online bank payment. Tickets are not bookable. Ticket can be sold to the particular line, but not with particular seating location. The ticket can be cancelled, but GRE returns only a portion of the ticket price. Cancellation can be handled via Internet or via phone services. The closer to departure, the lower part of the price shall be refunded. In addition to ticket cancellation, it is possible to inquire about bus schedule information via phone service. Tickets are electronic tickets delivered via e-mail. The driver checks the right to travel by reading the barcode on the ticket using mobile reading terminal. GRE hires workers for different tasks. Traffic planner establishes and closes down lines. He also shifts in demand, and designs schedules. Price analyst adjusts prices depending on demand and competitors. Driver manager is the head of drivers and allocates drivers and buses, and schedules services and Transportation Department tests for the vehicles. GRE pays hourly rate for drivers and telephone service staff. Other staff will be paid by monthly salary basis. Non-core activities (accounting, payroll, vehicle maintenance, computer maintenance, etc.) will be outsourced.

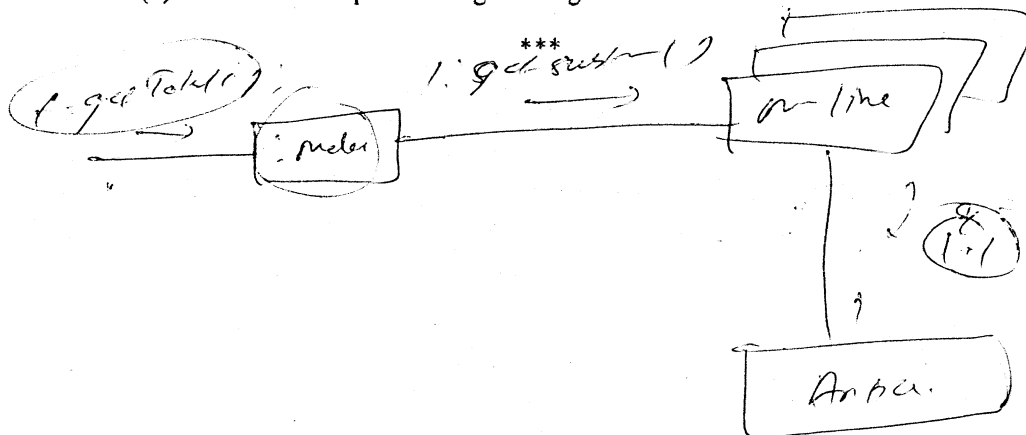
Prepare and draw Use Cases with elaboration for the above scenario.

- 5 Bottle recycling machine has a control unit, bottle sensor, belt unit, the sum counter, the end button and the receipt printer. There are at least states such as waiting, on run, on service and receipt printing. The "on run" state can be refined with sub-states working, blocked, failure notification, emptying. You can add few new states according to your own realization. [8]
 Draw a state diagram for the control unit
- 6 Your manager reviews your design and codes of a sub-module that you have prepared, as depicted in the below figure. She suggests you to introduce *subtotal()* somewhere in your model thinking about the performance of the system. [8]



Modify your implementation and justify how does this update provides you better performance.

- 7 What is exception and error handling in the context of system implementation? How does it differ from other conventional method versus the object-oriented method based implementation? [5+5]
- 8 Explain the forking, joining, and branching features available in object-oriented based modeling? How does these primitive provide the closest implementation model? Relate with any arbitrary sample. [4+4]
- 9 Write short notes. [2*5]
 (a) Focus of control
 (b) Methods of requirement gathering



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1. What are the main differences of OO based design cycle to other conventional design cycle? Explain with relevant example. [7]
2. In OOAD, there are various types of models, like conceptual, structural, behavioral, etc. What is the significance of these many different types of model? Explain with illustrative examples. [7]
3. How does the requirement elicitation process happen in object oriented analysis? Explain with reference to system behavior analysis of any exemplary system case. [7]
4. Prepare the list of essential components to be identified in building an activity diagram. Illustrate with an example of your own choice. [7]
5. The model depicts the online order processing system as illustrated in fig.1. Explain in detail of the diagram type with every symbols being used and semantics of this diagram. [8]

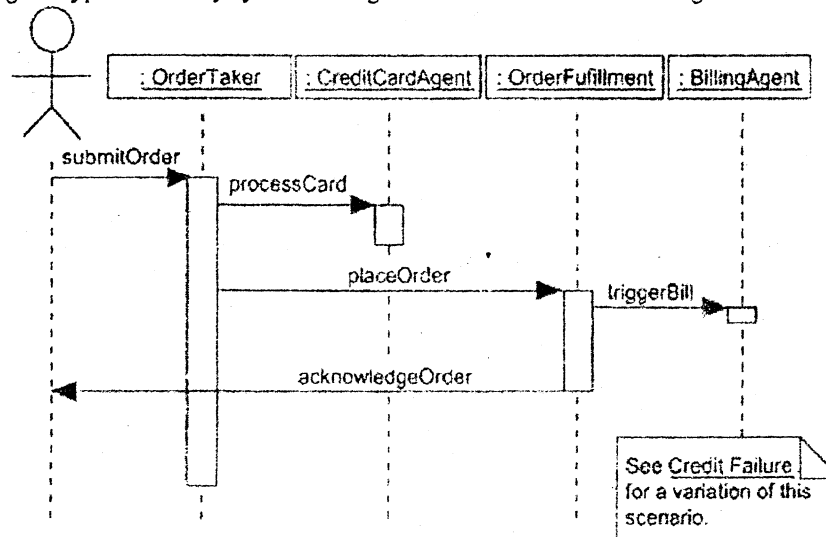


fig.1

6. Imagine your school friend, Miss DilKhus Kumari Vaidya, a very successful entrepreneur at early age, is offering you systems manager position with very good salary in her new business of event management. The proposed system is a complete Online-Event-Management-System (OEMs) that should handle not only event details, rather the revenue, expenditure and transaction details related to various headings of each event and also every personnel involved. Now you have to prepare executive summary and also a class diagram for making your case very strong among the stakeholders for making decision about the project finalization. [4+8]
7. Present the mapping process for the fig.1 model using object-oriented based pseudo-codes for capturing all important aspects of the model diagram. [7]
8. Prepare a comparative note on forward versus reverse engineering with mentioning the merits, demerits and implementation challenges. [7]
9. Explain the importance of error handling issues to be resolved in a system. [6]
10. Write short notes on [4*3]
- a) External agent in Use Case
 - b) Effect of design patterns in deployment
 - c) Issues on distributed system implementation

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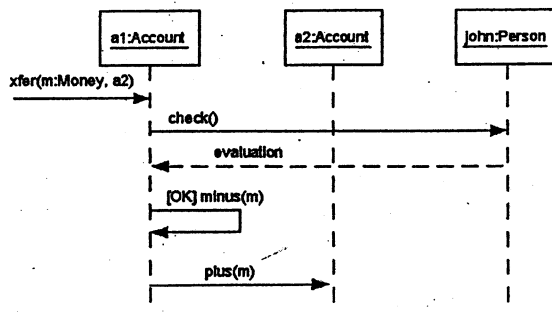
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- (1) What is the meaning of *Encapsulation* from the viewpoint of structured systems analysis and design? Explain how does *Encapsulation* and *Abstraction* concepts work together in object-orientation? [4 + 6]
- (2) Here are some of the requirements for a system that you are going to build for the Grand Care Hospital, which is coming in operation soon. Identify which of the following information are used in building **Conceptual, Specification and Implementation** model. [6]
 - (a) Each out-patient registration process takes an average of 90 seconds.
 - (b) Liver unit will treat the *Jaundice* patients.
 - (c) All bio-chemistry tests are carried out in Pathology department
 - (d) The newly installed GE USG machine can record diagnostic video too. Extended computer interfacing is required with Windows OS and mpeg-4 application.
 - (e) Each Gastro-patient going to operation theater (OT) is to be re-evaluated for bowel status exactly 30 minutes before their OT schedule.
 - (f) Some of the gastro-patients visit Liver unit too.
- (3) Explain four different types of relationships that we model in object-oriented analysis, which exists between two different classes represented as shown in below figure. [8]



- (4) Based on the below diagram for model action of money transfer, answer the following questions: [3*3]
 - (a) How many numbers of classes are involved in this transfer activity? What are they?
 - (b) What are the events followed for transfer complete?
 - (c) Why this *check()* function is required for this transfer?



(5) A new digital clock, recently available in the market, simultaneously displays the time and date. The time and date displays can be adjusted by the buttons available within the unit. The clock has two buttons, "mode" and "forward". If you wish to change the time you should first press the mode button, after which the time may be changed by the forward-button. If the mode button is pressed again, you can change the date (by the forward-button). If the mode button is pressed once again, you will go back to normal state. When the forward-button is pressed, the display will go a single unit (seconds or days) ahead. If the button is held down for more than two seconds, the display will change rapidly (once in every 0.2 second) ahead so long as the button is pressed.

[10]

Draw a state diagram for this clock control unit.

(6) Explain the forward and reverse engineering processes with outlining their merits and demerits in object-oriented implementation.

[10]

(7) The Premier Video Rental Shop (PVRs) decides to implement a database-based information system. PVRs acquires the video from the importer or chain trade. An agreement will be signed with both partners and it defines the date, number of copies, time frame of the lease and purchase price. As an additional info of importer also the address and bank details will be recorded. The customer rents a video from the PVRs. From each video the name, ID and rental price information will be recorded. The rental price is calculated from the rental period, the purchase price and the customer relationship. Video types include action, art and children's video. Video may also be a blend of action and art videos. As an action video info the degree of violence will be recorded, and from art videos the awards and from children's videos the age limit. The customer relationship can be a random customer, regular or member of PVRs club. As an overarching customer info the name will be recorded and from regular customer the cumulative sum of the number of rental events.

[12]

From the members of PVRs club information, the member address is used in order to advertise new products and offers.

Draw a class diagram, which presents the main classes, properties, methods, and relationships between classes.

(8) Write short notes.

[3*5]

- (a) Sequence diagram
- (b) Swimlanes
- (c) Polymorphic signal

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1. Explain object oriented system with reference to class, object, encapsulation, abstraction, message, inheritance, interface and polymorphism with suitable examples. [8]
2. IOE is willing to develop a system for the student result management of its BE program. Now prepare the problem statement from the side of Examination control Division. What are building blocks of UML? Explain with suitable examples and notations. [4+6]
3. A web-based online store has "Buy a Product" scenario as follows:
The customer browses the catalog and adds desired items to the shopping basket. When the customer wishes to pay, the customer describes the shipping and credit card information and confirms the sale. The system checks the authorization on the credit card and confirms the sale both immediately and with a follow-up e-mail.
Now construct conceptual model for this scenario. [6]
4. Draw a class diagram for point of sale system with association and multiplicity. [6]
5. Read the following case study carefully and answer the given questions.
Ministry of Health and Population is willing to computerize its system. This new system will be able to tell the population of the country, zone and district and even of the ward of specific place. The system will update its data in monthly basis so that the birth rate and death rate can be easily seen. The home page is displayed when a person enters to the system. Administrators can enter to the admin panel by logging in with an ID and a password. He/she has privileges to enter and modify the data into the database. On the other hand, normal users can view the data but not modify them. They can also visualize the data in graphical form with animated charts, maps as well as in tabular form based on their selection of data. Besides, they can also view the forecasted data. (Make your assumptions if necessary)
Draw collaboration diagram and use case diagram. [6+6]
6. What is framework? How design pattern is useful? Explain any one design pattern in detail with suitable example. [6]
7. Explain development process with suitable example. How can you map design into code? Illustrate with diagrams produced in question number five by using any object oriented languages like C++, Java, C# etc. [4+7]
8. Construct a system sequence diagram for customer from a "Food ordering system" of a very busy restaurant where seating and ordering is regulated by seating manager. [6]
9. Illustrate how can you create classes from design class diagrams and methods from interaction diagrams (Use C#, Java etc.). [6]
10. Write short notes on: [3×3]
 - a) Iterative cycles of development
 - b) Synchronization bar
 - c) Flow of object