

**UNIT I**

**Chapter 1 : Concepts of Software Modeling**  
1-1 to 1-44

**Syllabus : Software Modeling :** Introduction to Software Modeling, Advantages of modeling, Principles of modeling.  
**Evolution of Software Modeling and Design Methods :** Object oriented analysis and design methods, Concurrent, Distributed Design Methods and Real-Time Design Methods, Model Driven Architecture (MDA), 4+1 Architecture, Introduction to UML, UML building Blocks, COMET Use Case-Based Software Life Cycle.  
**Requirement Study :** Requirement Analysis, SRS design, Requirements Modeling. **Use Case :** Actor and Use case identification, Use case relationship (Include, Extend, Use case Generalization, Actor Generalization), Use case template.

**1.1 Introduction to Software Modeling ..... 1-1**

1.1.1 Advantages of Modeling ..... 1-2

1.1.2 Why do We Model ? ..... 1-2

1.1.3 Benefits of Visual Modeling..... 1-3

1.1.4 Principles of Modeling..... 1-3

**1.2 Evolution of Software Modeling and Design Methods ..... 1-3**

1.2.1 Object Oriented Analysis and Design Methods ..... 1-4

1.2.2 Concurrent, Distributed Design Methods and Real-Time Design Methods..... 1-5

1.2.3 Model Driven Architecture (MDA)..... 1-6

1.2.4 4+1 Architecture..... 1-7

1.2.4(A) Why is it Called the 4 + 1 Instead of just 5 ?..... 1-8

1.2.4(B) 4+1 View of UML Diagrams..... 1-9

1.2.4(C) Why 4+1 Architecture ..... 1-9

1.2.5 Introduction to UML..... 1-9

1.2.5(A) Introduction to Unified Modeling Language ....1-10

1.2.5(B) UML Supports Requirements Modeling.....1-11

1.2.6 UML Building Blocks .....1-11

1.2.6(A) Things in UML ..... 1-11

1.2.6(B) Relationship in UML..... 1-14

1.2.6(C) Diagrams in UML ..... 1-15

1.2.7 COMET Use Case - Based Software Life Cycle ..... 1-15

**1.3 Requirement Study ..... 1-17**

1.3.1 Types of Requirements..... 1-17

1.3.1(A) Functional Requirements ..... 1-18

1.3.1(B) Non-Functional Requirements..... 1-18

1.3.2 Requirement Analysis ..... 1-19

1.3.3 SRS Design ..... 1-20

1.3.4 Organization of SRS Document ..... 1-21

1.3.5 SRS for UMS (University Management System) ..... 1-25

1.3.5(A) General Description..... 1-25

1.3.5(B) Overall Description..... 1-25

1.3.6 Specific Requirements ..... 1-26

1.3.6(A) External Interface Required ..... 1-26

1.3.6(B) Performance Requirements ..... 1-26

1.3.6(C) Design Constraints..... 1-26

1.3.6(D) Attributes ..... 1-26

1.3.6(E) Other Requirements..... 1-26

1.3.7 Requirements Modeling ..... 1-27

1.3.8 Managing Changing Requirement ..... 1-29

**1.4 Use Case Modeling ..... 1-30**

1.4.1 Use Case Diagram..... 1-30

1.4.2 Actor and Use Case Identification..... 1-31

1.4.3 Use Case Relationship ..... 1-33

1.4.3(A) Include..... 1-33

1.4.3(B) Extend..... 1-34

1.4.3(C) Use Case Generalization ..... 1-35

1.4.3(D) Actor Generalization ..... 1-36

1.4.4 Use Case Specification ..... 1-37

1.4.5 Use Case Template ..... 1-39

1.4.6 Solved Examples ..... 1-41

**UNIT II**

**Chapter 2 : Static Modeling 2-1 to 2-48**

**Syllabus :** Study of classes (analysis level and design level classes). **Methods for identification of classes :** RUP (Rational Unified Process), CRC (Class, Responsibilities and Collaboration), Use of Noun Verb analysis (for identifying entity classes, controller classes and boundary classes).

**Class Diagram :** Relationship between classes, Generalization/Specialization Hierarchy, Composition and Aggregation Hierarchies, Associations Classes, Constraints.

Object diagram, Package diagram, Component diagram, Composite Structure diagram, Deployment Diagram.

**2.1 Introduction to Static Modeling..... 2-1**

**2.2 Study of Classes..... 2-1**

**2.3 Method of Identifying Classes..... 2-2**

2.3.1 Rational Unified Process Model ..... 2-2

2.3.2 CRC (Class Responsibilities Collaboration) ..... 2-4

2.3.3 Use of Noun Verb Analysis ..... 2-4

2.3.4 Common Class Pattern..... 2-6

2.3.5 Identifying Boundary, Entity and Control Classes..... 2-6

2.3.5(A) Boundary Class ..... 2-6

2.3.5 (B) Control Classes..... 2-8

2.3.5 (C) Entity Classes..... 2-8

**2.4 Class Diagram ..... 2-9**

2.4.1 Class Structure ..... 2-9

2.4.2 Identifying Attributes .....2-11

2.4.3 Identifying Operation .....2-11

2.4.4 Relationship between Classes.....2-13

2.4.4(A) Association.....2-13

2.4.4(B) Generalization/Specialization Hierarchy.....2-15

2.4.4(C) Aggregate /Composite Hierarchy .....2-16

2.4.4(D) Composite Relationships.....2-17

2.4.5 Association Classes .....2-18

2.4.6 Constraints .....2-18

2.4.7 Solved Examples .....2-20

**2.5 Object Diagram .....2-29**

**2.6 Package Diagram.....2-31**

**2.7 Component Diagram.....2-32**

2.7.1 Types of Components / Elements of Component Diagram .....2-33

2.7.2 Interface.....2-34

**2.8 Composite Structure Diagrams.....2-35**

2.8.1 Part.....2-35

2.8.2 Port.....2-35

2.8.3 Interfaces .....2-36

2.8.4 Delegate .....2-36

**2.9 Deployment Diagram .....2-37**

2.9.1 Elements of a Deployment Diagram .....2-37

2.9.2 When to use Deployment Diagram .....2-37

**UNIT III**

**Chapter 3 : Dynamic Modeling 3-1 to 3-39**

**Syllabus : Activity diagram :** Different Types of nodes, Control flow, Activity Partition, Exception handler, Interruptible activity region, Input and output parameters, Pins.

**Interaction diagram :** Sequence diagram, Interaction Overview diagram, State machine diagram, Advanced State Machine diagram, Communication diagram, Timing diagram.

**3.1 Activity Diagram..... 3-1**

3.1.1 Different Types of Nodes .....3-2

3.1.1(A) Initial and Final Activity .....3-2

3.1.1(B) Decision and Merge Points.....3-3

3.1.1(C) Forking and Joining .....3-3

3.1.2 Activity Edge / Control Flow.....3-4

3.1.3 Activity Partitions .....3-4

3.1.3(A) Swimlanes.....3-4

3.1.4 Exception Handler..... 3-5

3.1.5 Interruptible Activity Region ..... 3-6

3.1.6 Input and Output Parameters And Pin ..... 3-6

3.1.6(A) Input and Output Pins ..... 3-6

3.1.7 Creating Activity Diagram ..... 3-7

3.1.8 Solved Examples ..... 3-8

**3.2 Interaction Diagram..... 3-14**

**3.3 Sequence Diagram ..... 3-15**

3.3.1 Elements of Sequence Diagram.....3-16

3.3.1(A) Objects and Roles.....3-16

3.3.1(B) Link.....3-16

3.3.1(C) Object Life Line .....3-17

3.3.1(D) Message or Stimulus.....3-17

3.3.1(E) Focus of control .....3-18

3.3.1(F) End of a Lifeline .....3-18

3.3.1(G) Conditional Message .....3-18

3.3.2 Creating Sequence Diagram.....3-18

3.3.3 Modeling Interactions .....3-19

**3.4 Interaction Overview Diagram..... 3-23**

**3.5 State Diagrams ..... 3-23**

3.5.1 Element of State Diagram .....3-24

3.5.1(A) State Machine .....3-24

3.5.1(B) Initial and Final State .....3-26

3.5.1(C) Triggers and Ports.....3-26

3.5.1(D) Transitions.....3-26

**3.6 Advanced State Machine Diagram..... 3-27**

3.6.1(A) Composite States.....3-27

3.6.1(B) Orthogonal State .....3-28

3.6.1(C) Submachine States .....3-29

**3.7 Communication Diagram..... 3-35**

**3.8 Timing Diagram ..... 3-36**

**UNIT IV**

**Chapter 4 : Software Architecture and Quality Attributes 4-1 to 4-13**

**Syllabus** : Introduction to Software Architecture, Importance of Software Architecture, Architectural Structure and Views. **Architectural Pattern** : common module, Common component-and-connector, Common allocation.

**Quality Attributes** : Architecture and Requirements, Quality Attributes and Considerations

**4.1 Introduction..... 4-1**

**4.2 Overview of Software Architecture ..... 4-2**

**4.3 Architectural Structure and Views ..... 4-3**

4.3.1 Architectural Structure.....4-3

4.3.2 Architectural View .....4-3

**4.4 Architectural Pattern..... 4-4**

4.4.1 Common Module Patterns.....4-4

4.4.1(A) Layered Pattern.....4-4

4.4.2 Component and Connector Pattern .....4-5

4.4.2(A) The Broker Architectural Pattern.....4-5

4.4.2(B) Model-View-Controller Architectural Pattern.....4-5

4.4.2(C) Client Server Pattern .....4-6

4.4.2(D) Publish Subscribe Pattern .....4-7

4.4.2(E) Service Oriented Architecture Pattern.....4-8

4.4.3 Allocation Pattern .....4-9

4.4.3(A) Map Reduce Pattern.....4-9

4.4.3(B) Multi-tier Pattern .....4-9

**4.5 Quality Attributes .....4-10**

**4.6 Architecture and Requirements.....4-11**

**4.7 Quality Attributes and Considerations .....4-12**

**UNIT V**

**Chapter 5 : Architectural Design and Documentation**  
5-1 to 5-8

**Syllabus : Architecture in the Life Cycle :** Architecture in Agile Projects, Architecture and Requirements, Designing an Architecture.  
**Documenting Software Architecture :** Notations, Choosing and Combining views, Building the documentation Package, Documenting Behavior, Documenting Architecture in an Agile Development Project.

**5.1 Architecture in the Life Cycle ..... 5-1**

5.1.1 Architecture in Agile Projects ..... 5-2

5.1.2 Architecture and Requirements ..... 5-2

5.1.3 Designing an Architecture ..... 5-3

5.1.3(A) Attribute Driven Design (ADD) ..... 5-3

**5.2 Documenting Software Architecture ..... 5-5**

5.2.1 Notations ..... 5-5

5.2.2 Choosing and Combining View ..... 5-5

5.2.3 Building the Documentation Package ..... 5-6

5.2.4 Documenting Behavior ..... 5-6

5.2.5 Documenting Architecture in an Agile Development Project ..... 5-7

5.2.5(A) Architecture Decision Records ..... 5-7

5.2.5(B) The C4 Model ..... 5-7

**UNIT VI**

**Chapter 6 : Design Patterns** 6-1 to 6-22

**Syllabus : Design Patterns :** Introduction, Different approaches to select Design Patterns.  
**Creational patterns :** Singleton, Factory,  
**Structural pattern :** Adapter, Proxy.  
**Behavioral Patterns :** Iterator, Observer Pattern with applications.

**6.1 Design Patterns: Introduction..... 6-1**

6.1.1 What is Design Pattern ? .....6-1

6.1.2 Why to Use Design Pattern ? .....6-1

6.1.3 Classification of Design Patterns .....6-2

6.1.3(A) Creational Design Patterns .....6-2

6.1.3(B) Structural Design Patterns .....6-3

6.1.3(B) Behavioral Design Patterns .....6-4

6.1.4 Design Pattern Template/  
Documenting Design Pattern .....6-5

**6.2 Different Approaches to Select Design Patterns..... 6-6**

**6.3 Creational Patterns ..... 6-7**

6.3.1 Singleton Pattern .....6-7

6.3.2 Factory Pattern.....6-8

**6.4 Structural Pattern.....6-11**

6.4.1 Adapter Pattern.....6-11

6.4.2 Proxy Pattern .....6-15

**6.5 Behavioral Patterns .....6-17**

6.5.1 Iterator Pattern .....6-18

6.5.2 Observer Pattern with Applications .....6-19

➤ **Case Studies ..... C-1 to C-65**