

## Object Oriented Analysis and Design

**Course Title:** Object Oriented Analysis and Design

**Course No:** MIT501

**Nature of the Course:** Theory + Lab

**Semester:** I

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs:** 3

### Course Description:

This course familiarizes students with the concepts of information systems development using object-oriented concepts. Special focus will be given to system development life cycle, development methodologies, and different phases of systems development such as analysis, design, construction, installation and operation.

### Course Objectives:

By the end of this course, students will be able to use different object-oriented concepts of information systems development to develop information systems using different methodologies, tools, and techniques.

### Course Contents:

Unit	Contents	Hour
<b>1</b> <b>(9 Hrs.)</b> <b>Introduction</b>	Introduction; Roles and Skills of Systems Analyst	<b>0.5</b>
	Systems Development Life Cycle	<b>0.5</b>
	Systems Development Methodologies <ul style="list-style-type: none"><li>• Structured Design</li><li>• Rapid Application Development</li></ul>	<b>1</b>
	Object-Oriented Systems Analysis and Design <ul style="list-style-type: none"><li>• Use-Case Driven</li><li>• Architecture-Centric</li><li>• Iterative and Incremental</li><li>• Benefits of Object-Oriented Systems Analysis and Design</li></ul>	<b>1.5</b>
	Agile Development, DevOps, Custom Methodologies	<b>2</b>
	Unified Process <ul style="list-style-type: none"><li>• Phases</li><li>• Workflows</li><li>• Extensions to the Unified Process</li></ul>	<b>1.5</b>
	Unified Modeling Language	<b>1</b>
	Basic Characteristics of Object-Oriented Systems <ul style="list-style-type: none"><li>• Classes and Objects</li></ul>	<b>1</b>

	<ul style="list-style-type: none"> <li>• Methods and Messages</li> <li>• Encapsulation and Information Hiding</li> <li>• Inheritance</li> <li>• Polymorphism and Dynamic Binding</li> </ul>	
<b>2</b>  <b>(18 Hrs.)</b>  <b>Analysis Modeling</b>	<b>Requirements Determination (3 Hrs.)</b>	
	Introduction	<b>1</b>
	Requirements Determination <ul style="list-style-type: none"> <li>• Requirements Determination</li> <li>• Defining a Requirement</li> <li>• Requirements Definition</li> <li>• Determining Requirements</li> <li>• Creating a Requirements Definition</li> <li>• Real-World Problems with Requirements Determination</li> </ul>	
	Requirements Analysis Approaches <ul style="list-style-type: none"> <li>• Problem Analysis</li> <li>• Root Cause Analysis</li> <li>• Duration Analysis</li> <li>• Activity-Based Costing</li> <li>• Informal Benchmarking</li> <li>• Outcome Analysis</li> <li>• Technology Analysis</li> <li>• Activity Elimination</li> </ul>	<b>1</b>
	Requirements Gathering Techniques <ul style="list-style-type: none"> <li>• Interviews</li> <li>• Joint Application Development (JAD)</li> <li>• Questionnaires</li> <li>• Document Analysis</li> <li>• Observation</li> <li>• Selecting the Appropriate Techniques</li> </ul>	<b>0.5</b>
	Text Analysis	<b>0.5</b>
	Requirements Definition; System Proposal	
	<b>Business Process and Functional Modeling (6 Hrs.)</b>	
	Introduction  Business Process Modeling with Use Case Diagrams <ul style="list-style-type: none"> <li>• Elements of Use-Case Diagrams</li> <li>• Identifying the Major Use Cases</li> </ul>	<b>1.5</b>

<ul style="list-style-type: none"> <li>• Creating a Use-Case Diagram</li> </ul>	
Business Process Modeling with Activity Diagrams	<b>1.5</b>
<ul style="list-style-type: none"> <li>• Elements of an Activity Diagram</li> <li>• Guidelines for Creating Activity Diagrams</li> <li>• Creating Activity Diagrams</li> </ul>	
Business Process Identification with Use Cases and Use-Case Diagram	<b>0.5</b>
Business Process Documentation with Use-Case Descriptions	<b>1.5</b>
<ul style="list-style-type: none"> <li>• Cases and Use-Case Descriptions</li> <li>• Types of Use Cases</li> <li>• Elements of a Use-Case Description</li> <li>• Guidelines for Creating Use-Case Descriptions</li> <li>• Creating Use Case Descriptions</li> </ul>	
Verifying and Validating Business Process and Functional Models	<b>1</b>
<ul style="list-style-type: none"> <li>• Processes and Functional Models</li> <li>• Verification and Validation through Walkthroughs</li> <li>• Functional Model Verification and Validation</li> </ul>	
<b>Structural Modeling (5 Hrs.)</b>	
Introduction	<b>0.5</b>
Structural Models	
<ul style="list-style-type: none"> <li>• Classes, Attributes, and Operations</li> <li>• Relationships</li> </ul>	
Object Identification	<b>0.5</b>
<ul style="list-style-type: none"> <li>• Textual Analysis</li> <li>• Brainstorming</li> <li>• Common Object Lists</li> <li>• Patterns</li> </ul>	
CRC Cards	<b>1</b>
<ul style="list-style-type: none"> <li>• Responsibilities and Collaborations</li> <li>• Elements of a CRC Card</li> <li>• Role-Playing CRC Cards with Use Cases</li> </ul>	
Class Diagrams	<b>1</b>
<ul style="list-style-type: none"> <li>• Elements of a Class Diagram</li> <li>• Simplifying Class Diagrams</li> <li>• Object Diagrams</li> </ul>	
Structural Models using CRC Cards and Class Diagrams	<b>1.5</b>

	<ul style="list-style-type: none"> <li>• Campus Housing Example</li> <li>• Library Example</li> </ul>	
	Verifying and Validating Structural Models	<b>0.5</b>
	<b>Behavioral Modeling (4 Hrs.)</b>	
	Introduction	<b>0.5</b>
	Behavioral Models	
	Interaction Diagrams	<b>1.25</b>
	Behavioral State Machines	<b>1.25</b>
	CRUDE Analysis	<b>0.5</b>
	Verifying and Validating Behavioral Models	<b>0.5</b>
<b>3</b>	<b>Moving on to Design (1.5 Hrs.)</b>	
<b>(12 Hrs.)</b>	Introduction	<b>0.5</b>
<b>Design Modeling</b>	Verifying and Validating Analysis Models <ul style="list-style-type: none"> <li>• Balancing Functional and Structural Models</li> <li>• Balancing Functional and Behavioral Models</li> <li>• Balancing Structural and Behavioral Models</li> </ul>	
	Evolving Analysis Models into Design Models <ul style="list-style-type: none"> <li>• Factoring</li> <li>• Partitions and Collaborations</li> <li>• Layers</li> </ul>	<b>0.25</b>
	Packages and Package Diagrams <ul style="list-style-type: none"> <li>• Guidelines for Creating Package Diagrams</li> <li>• Creating Package Diagrams</li> <li>• Verifying and Validating Package Diagrams</li> </ul>	<b>0.25</b>
	Design Criteria and Strategies <ul style="list-style-type: none"> <li>• Custom Development</li> <li>• Packaged Software</li> <li>• Outsourcing</li> <li>• Selecting a Design Strategy</li> </ul>	<b>0.25</b>
	Selecting Acquisition Strategy <ul style="list-style-type: none"> <li>• Alternative Matrix</li> </ul>	<b>0.25</b>

<b>Class and Method Design (2 Hrs.)</b>	
Introduction	<b>0.5</b>
Object Design Activities <ul style="list-style-type: none"> <li>• Adding Specifications</li> <li>• Identifying Opportunities for Reuse</li> <li>• Restructuring the Design</li> <li>• Optimizing the Design</li> <li>• Mapping Problem-Domain Classes to Implementation Languages</li> </ul>	
Constraints and Contracts <ul style="list-style-type: none"> <li>• Types of Constraints</li> <li>• Elements of a Contract</li> </ul>	<b>0.5</b>
Method Specification <ul style="list-style-type: none"> <li>• General Information</li> <li>• Events</li> <li>• Message Passing</li> <li>• Algorithm Specifications</li> </ul>	<b>0.5</b>
Verifying and Validating Class and Method Design	<b>0.5</b>
<b>Data Management Layer Design (3 Hrs.)</b>	
Introduction	<b>1</b>
Object Persistence Formats <ul style="list-style-type: none"> <li>• Sequential and Random Access Files</li> <li>• Relational Databases</li> <li>• Object-Relational Databases</li> <li>• Object-Oriented Databases</li> <li>• NoSQL Data Stores</li> <li>• Selecting an Object Persistence Format</li> </ul>	
Mapping Problem Domain Objects to Object Persistence Formats <ul style="list-style-type: none"> <li>• Mapping Problem Domain Objects to an OODBMS Format</li> <li>• Mapping Problem Domain Objects to an ORDBMS Format</li> <li>• Mapping Problem Domain Objects to a RDBMS Format</li> </ul>	<b>1</b>
Designing Data Access and Manipulation Classes  Nonfunctional Requirements and Data Management Layer Design Verifying and Validating Data Management Layer	<b>1</b>

<b>Human Computer Interaction Layer Design (3 Hrs.)</b>		
Introduction		<b>0.5</b>
Principles for User Interface Design <ul style="list-style-type: none"> <li>• Layout</li> <li>• Content Awareness</li> <li>• Aesthetics</li> <li>• User Experience</li> <li>• Consistency</li> <li>• Minimizing User Effort</li> </ul>		
User Interface Design Process <ul style="list-style-type: none"> <li>• User Interface Design Process</li> <li>• Use Scenario Development</li> <li>• Navigation Structure Design</li> <li>• Interface Standards Design</li> <li>• Interface Design Prototyping</li> <li>• Interface Evaluation</li> <li>• Common Sense Approach to User Interface Design</li> </ul>		<b>1</b>
Navigation Design <ul style="list-style-type: none"> <li>• Basic Principles</li> <li>• Types of Navigation Controls</li> <li>• Messages</li> <li>• Navigation Design Documentation</li> </ul>		<b>0.5</b>
Input and Output Design <ul style="list-style-type: none"> <li>• Basic Principles of Input and Output</li> <li>• Types of Inputs</li> <li>• Input Validation</li> <li>• Types of Outputs</li> <li>• Media</li> </ul>		<b>0.5</b>
International and Cultural Issues and User Interface Design <ul style="list-style-type: none"> <li>• Color</li> <li>• Cultural Differences</li> </ul>		<b>0.5</b>
Nonfunctional Requirements and Human Computer Interaction Layer		
<b>Physical Architecture Layer Design (2.5 Hrs.)</b>		

	<p>Introduction</p> <p>Elements of Physical Architecture layer</p> <ul style="list-style-type: none"> <li>• Architectural Components</li> <li>• Server-Based Architectures</li> <li>• Client-Based Architectures</li> <li>• Client–Server Architectures</li> <li>• Client–Server Tiers</li> <li>• Selecting a Physical Architecture 4</li> </ul>	<b>0.5</b>
	<p>Infrastructure Design</p> <ul style="list-style-type: none"> <li>• Deployment Diagram</li> <li>• Network Model</li> </ul>	<b>0.5</b>
	<p>Hardware and System Software Specifications</p>	<b>0.25</b>
	<p>Nonfunctional Requirements and Physical Architecture Layer Design</p> <ul style="list-style-type: none"> <li>• Operational Requirements</li> <li>• Performance Requirements</li> <li>• Security Requirements</li> <li>• Cultural and Political Requirements</li> </ul>	<b>1</b>
	<p>Verifying and Validating Physical Architecture Layer</p>	<b>0.25</b>
<b>4</b>	<b>Construction (3 Hrs.)</b>	
<b>Construction, Installation, and Operation  (6 Hrs.)</b>	<p>Introduction</p> <p>Managing Programming</p> <ul style="list-style-type: none"> <li>• Assigning Programmers</li> <li>• Coordinating Activities</li> <li>• Managing the Schedule</li> <li>• Cultural Issues</li> </ul>	<b>1</b>
	<p>Developing Documentation</p> <ul style="list-style-type: none"> <li>• Types of Documentation</li> <li>• Designing Documentation Structure</li> <li>• Writing Documentation Topics</li> <li>• Identifying Navigation Terms</li> </ul>	<b>1</b>
	<p>Designing Tests</p> <ul style="list-style-type: none"> <li>• Designing Tests</li> <li>• Testing and Object Orientation</li> </ul>	<b>1</b>

	<ul style="list-style-type: none"> <li>• Test Planning</li> <li>• Unit Tests</li> <li>• Integration Tests</li> <li>• System Tests</li> <li>• Acceptance Tests</li> </ul>	
<b>Installation and Operation (3 Hrs.)</b>		
	Introduction	<b>0.5</b>
	Cultural Issues and IT Adoption	
	Conversion <ul style="list-style-type: none"> <li>• Conversion Style</li> <li>• Conversion Location</li> <li>• Conversion Modules</li> <li>• Selecting the Appropriate Conversion Strategy</li> </ul>	<b>1</b>
	Change Management <ul style="list-style-type: none"> <li>• Understanding Resistance to Change</li> <li>• Revising Management Policies</li> <li>• Assessing Costs and Benefits</li> <li>• Motivating Adoption</li> <li>• Enabling Adoption: Training</li> </ul>	<b>1</b>
	Post Implementation Activities <ul style="list-style-type: none"> <li>• System Support</li> <li>• System Maintenance</li> <li>• Project Assessment</li> </ul>	<b>0.5</b>

**Laboratory / Project Work:** Students will learn to use CASE tools and modeling tools to draw different UML and other related diagrams. They also prepare a project report that includes at least analysis, design, and implementation phases of object-oriented system analysis and design. The project can be completed using any suitable database, programming, and interfacing technologies.

**References:**

1. Alan Dennis, Barbara Haley Wixom, and David Tegarden, *Systems Analysis and Design – An Object-Oriented Approach with UML*, 6<sup>th</sup> Edition, Wiley, 2021
2. Raul Sidnei Wazlawick, *Object-Oriented Analysis and Design for Information Systems: Modeling with UML, OCL, and IFML*, Morgan Kaufmann, 2014
3. Simon Bennett, Steve McRobb and Ray Farmer, *Object-Oriented System Analysis and Design using UML*, 4<sup>th</sup> Edition, McGraw-Hill, 2010
4. Joseph S. Valacich and Joey F. George, *Modern Systems Analysis and Design*, 9<sup>th</sup> Edition, Pearson



**Tribhuvan University**  
**Institute of Science and Technology**  
**Model Question**

**Master Level/ First Year/ First Semester**  
**Information Technology (MIT501)**  
**(Object Oriented Analysis and Design)**

**Full Marks: 45**  
**Pass Marks: 22.5**  
**Time: 2 hours**

**Section A**

**Attempt any two questions. [2 x 10 =20]**

1. Explain unified process with a neat diagram. What are the benefits of Object Oriented System analysis and design? [8+2]
2. A flood prediction system works on the basis of catchment area, river characteristics, water level. It provides notifications in three different categories: normal, tolerable and evacuate. It also generates the past historical data. A user has to input the location to access different notifications. It also provides the best route for evacuation to a safe place based on the location. The system is integrated with the evacuation team and local police station to help in evacuation process. [10]

Draw use case diagram, communication diagram for the above scenario. Similarly, draw behavior state model of the user.

3. Suggest a physical architecture design for online movie management system and portray it with a deployment diagram. Make necessary assumptions. [10]

**Section B**

**Attempt any five questions. [5 x 5 =25]**

4. Explain any three requirement analysis strategies. [5]
5. Illustrate on the importance of CRUDE matrix with an example. [5]
6. Highlight on the principles of user interface design. [5]
7. Define factoring, partitions and collaborations with an example. [5]
8. List important factors that have to be considered in selecting a conversion strategy and explain them. [5]
9. Write short notes on [2\*5=10]
  - a. DevOps
  - b. Object Persistence

## Advanced Database System

**Course Title:** Advanced Database System

**Course No:** MIT502

**Nature of the Course:** Theory + Lab

**Semester:** I

**Full Marks:** 45+30

**Pass Marks:** 22.5+15

**Credit Hrs:** 3

### Course Description:

This course introduces the advanced database concepts. The topics covered include object and object relational database, query processing and query optimization, distributed databases, NOSQL database, big data storage, big data technologies, active, temporal, spatial, multimedia, and deductive databases and information retrieval and web search.

### Course Objectives:

The main objective of this course is to make students familiar with the advanced concepts of database systems so that upon completion of the course students will be able to understand and use the advanced concepts to solve problems related to the database systems.

### Course Contents:

Unit	Contents	Hours
<b>1</b> <b>(5 Hrs.)</b> <b>Object and</b> <b>Object-</b> <b>Relational</b> <b>Databases</b>	Overview of Object-Oriented concepts (Object-Oriented Concepts and Features; Object Identity, Objects, and Literals; Complex Type Structures; Encapsulation of Operations and Persistence of Objects; Type Hierarchies and Inheritance; Polymorphism of Operations and Operator Overloading; Multiple Inheritance and Selective Inheritance)	1.5 Hrs.
	Object database extension to SQL (CREATE TYPE; Complex Objects; Object Identifiers Using Reference Types; Creating Tables Based on the UDTs; Encapsulation of Operations; Specifying Inheritance and Overloading of Functions; Specifying Relationships via Reference)	1 Hrs.
	The ODMG object model and the Object Definition Language (Overview; Inheritance; Built-in Interfaces and Classes; Atomic Objects; Extents, Keys, and Factory Objects; Object Definition Language)	1 Hr.
	Object Database Conceptual Design (Differences between Conceptual Design of ODB and RDB; Mapping an EER Schema to an ODB Schema)	0.5 Hr.
	The Object Query Language (Simple OQL Queries, Database Entry Points, and Iterator Variables; Query Results and Path Expressions; Specifying Views; Extracting Single Elements from Singleton Collections;	1 Hr.

	Collection Operators; Ordered Collection Expressions; Grouping Operator)	
<b>2 (11 Hrs.) Query Processing and Optimization</b>	Introduction to Query Processing; Translating SQL Queries into Relational Algebra and Semi Join and Anti Join	0.5 Hr.
	Algorithms for External Sorting; Algorithms for SELECT Operation (Implementation Options; Search Methods for Conjunctive and Disjunctive Selection; Estimating the Selectivity of a Condition)	1 Hr.
	Implementing the JOIN Operation (Implementation Methods; Effect of Buffer Space and Choice of Outer-Loop File; Effect of Join Selection Factor; General Case for Partition-Hash Join; Hybrid Hash-Join)	1 Hr.
	Algorithms for PROJECT and Set Operations (Use of Anti-Join for SET DIFFERENCE)	0.5 Hr.
	Implementing Aggregate Operations and Different types of JOINS (Implementing MIN, MAX, COUNT, AVERAGE, SUM; Implementing Outer Joins, Semi-Join, Anti-Join, and Non-Equi-Join)	0.5 Hr.
	Combining Operations Using Pipelining (Iterators for implementing Physical Operations)	0.5 Hr.
	Parallel Algorithms for Query Processing (Operator-Level Parallelism; Intraquery and Interquery Parallelism)	1 Hr.
	Introduction to Query Optimization; Query Trees and Heuristics for Query Optimization (Notation for Query Trees and Query Graphs; Heuristic Optimization of Query Trees)	1 Hr.
	Choice of Query Execution Plans (Alternatives for Query Evaluation; Nested Subquery Optimization; Subquery Merging Transformation; Materialized Views)	1.5 Hr.
	Use of Selectivities in Cost-Based Optimization (Cost components for Query Execution; Catalog Information Used in Cost Functions; Histograms)	1 Hr.
Cost Functions for SELECT Operation	0.5 Hr.	

	Cost Functions for the JOIN Operation (Join Selectivity and Cardinality for Semi-Join and Anti-Join; Multirelation Queries and JOIN Ordering Choices; Physical Optimization; Dynamic Programming Approach to Join Ordering)	1 Hr.
	Additional Issues Related to Query Optimization (Displaying the System's Query Execution Plan; Size Estimation of Projection, Set Operations, Aggregations, and Outer Join)	0.5 Hr.
	Query Optimization in Data Warehouses	0.5 Hr.
<b>3 (7 Hrs.) Distributed Database Concepts</b>	Distributed Database Concepts (Introduction; Transparency; Availability and Reliability; Scalability and Partition Tolerance; Autonomy; Advantages of Distributed Databases)	0.5 Hr.
	Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design (Data Fragmentation and Sharding; Data Replication and Allocation; Examples)	1 Hr.
	Overview of Concurrency Control and Recovery in Distributed Databases (Distributed Concurrency Control Based on a Distinguished Copy of a Data Item; Distributed Concurrency Control Based on Voting; Distributed Recovery)	1 Hr.
	Overview of Transaction Management in Distributed Databases (Two-Phase Commit Protocol; Three-Phase Commit Protocol; Operating System Support for Transaction Management)	1 Hr.
	Query Processing and Optimization in Distributed Databases (Distributed Query Processing; Data Transfer Costs of Distributed Query Processing; Distributed Query Processing Using Semijoin; Query and Update Decomposition)	1.5 Hrs.
	Types of Distributed Database Systems (Federated Database Management Systems Issues)	0.5 Hr.
	Distributed Database Architectures (Parallel versus Distributed Architectures; General Architecture of Pure Distributed Databases; Federated Database Schema Architecture; An Overview of Three-Tier Client/Server Architecture)	1 Hr.
	Distributed Catalog Management	0.5 Hr.

<b>4</b> <b>(6 Hrs.)</b> <b>NOSQL</b> <b>Databases and</b> <b>Big Data</b> <b>Storage</b> <b>Systems</b>	Introduction to NOSQL Systems (Emergence of NOSQL Systems; Characteristics of NOSQL Systems; Categories of NOSQL Systems)	1 Hrs.
	The CAP Theorem	0.5 Hrs.
	Document-Based NOSQL Systems and MongoDB (MongoDB Data Model; MongoDB CRUD Operations; MongoDB Distributed Systems Characteristics)	1.5 Hrs.
	NOSQL Key-Value Stores (DynamoDB Overview; Voldemort Key-Value Distributed Data Store)	1 Hrs.
	Column-Based or Wide Column NOSQL Systems (Hbase Data Model and Versioning; Hbase CRUD Operations; Hbase Storage and Distributed System Concepts)	1 Hrs.
	NOSQL Graph Databases and Neo4j (Neo4j Data Model; The Cypher Query Language of Neo4j; Neo4j Interfaces and Distributed System Characteristics)	1 Hrs.
<b>5</b> <b>(5 Hrs.)</b> <b>Big Data</b> <b>Technologies</b> <b>Based on</b> <b>MapReduce</b> <b>and Hadoop</b>	Introduction to Big Data	0.5
	Introduction to MapReduce and Hadoop (Historical Background; MapReduce)	1.5 Hrs.
	Hadoop Distributed File System (Preliminaries; Architecture; File I/O Operations and Replica Management; Scalability; Hadoop Ecosystem)	1.5 Hrs.
	MapReduce Runtime; Joins in MapReduce, Apache Hive, YARN	1.5 Hrs.
<b>6</b> <b>(5 Hrs.)</b> <b>Enhanced</b> <b>Data Models:</b> <b>Introduction</b> <b>to Active,</b> <b>Temporal,</b> <b>Spatial,</b> <b>Multimedia,</b> <b>and Deductive</b> <b>Databases</b>	Active Database Concepts and Triggers (Generalized Model for Active Databases and Triggers; Design and Implementation Issues; Applications; Triggers in SQL)	1 Hrs.
	Temporal Database Concepts (Time Representation, Calendars, and Time Dimensions; Incorporating Time in Relational Databases Using Tuple Versioning; Time Series Data)	1 Hrs.
	Spatial Database Concepts (Introduction; Spatial Data Types and Models; Spatial Operators and Spatial Queries; Spatial Data Indexing; Spatial Data Mining; Applications)	1 Hrs.
	Multimedia Database Concepts (Automatic Analysis of Images; Object Recognition in Images; Semantic Tagging of Images; Analysis of Audio Data Sources)	1 Hrs.

	Introduction to Deductive Databases (Overview; Prolog/Datalog Notation; Clausal Form and Horn Clauses; Interpretations of Rules)	1 Hrs.
<b>7 (6 Hrs.) Introduction to Information Retrieval and Web Search</b>	Information Retrieval Concepts (Introduction; Comparing Databases and IR Systems; Modes of Interaction; Generic IR Pipeline)	0.5 Hrs.
	Retrieval Models (Boolean Model; Vector Space Model; Probabilistic Model; Semantic Model)	1 Hrs.
	Types of Queries in Information Retrieval Systems (Keyword Queries; Boolean Queries; Phrase Queries; Proximity Queries; Wildcard Queries; Natural Language Queries)	1 Hrs.
	Text Preprocessing (Stopword Removal; Stemming Utilizing a Thesaurus; Digits, Hyphens, Punctuation Marks, and Cases; Information Extraction)	1 Hrs.
	Inverted Indexing	0.5 Hrs.
	Evaluation Measures of Search Relevance (Recall and Precision; Average Precision; Recall/Precision Curve; F-Score)	0.5 Hrs.
	Web Search and Analysis (Web Analysis and Its Relationship to Information Retrieval; Web Structure Analysis; Analyzing the Link Structure of Web Pages; Web Content Analysis; Approaches to Web Content Analysis; Web Usage Analysis; Practical Applications of Web Analysis)	1 Hrs.
	Trends in Information Retrievals (Faceted Search; Social Search; Conversational Information Access; Probabilistic Topic Modeling; Question Answering Systems)	0.5 Hrs.

### Laboratory Works

Laboratory works include implementing the concepts in above mentioned chapters using appropriate platforms.

### References:

1. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education, 7<sup>th</sup> Edition
2. Korth, Silberchatz, Sudarshan , Database System Concepts, McGraw-Hill, 7<sup>th</sup> Edition
3. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill
4. Peter Rob and Coronel, Database Systems, Design, Implementation and Management, Thomson Learning.
5. C.J. Date & Longman, Introduction to Database Systems, Pearson Education

**Tribhuvan University**  
**Institute of Science and Technology**  
**Model Question**

**Master Level/ First Year/ First Semester**  
**Information Technology (MIT502)**  
**(Advanced Database System)**

**Full Marks: 45**  
**Pass Marks: 22.5**  
**Time: 2 hours**

**Section A**

**Attempt any two questions. [2 x 10 =20]**

1. What is type constructor? Explain different type constructors of object-oriented database. What is object-relational database? [2+6+2]
2. Explain different steps in query processing. Also, explain different methods for implementing join operations in databases. [4+6]
3. What are the benefits of distributed databases? Explain fragmentation, replication, and allocations techniques for distributed database design. [2+8]

**Section B**

**Attempt any five questions. [5 x 5 =25]**

4. Define query optimization? What do you mean by heuristics for query optimization? [1.5+3.5]
5. What are different types of distributed database systems? Explain. [5]
6. What is CAP theorem? Explain document-based NOSQL system in brief. [2+3]
7. What is big data? Explain MapReduce programming model in brief. [2+3]
8. Define temporal database? Why do we need deductive databases? [1.5+3.5]
9. Explain vector space model of IR in brief. [5]

## Enterprise Application

**Course Title:** Enterprise Application  
**Course No:** MIT503  
**Nature of the Course:** Theory + Practical  
**Semester:** I

**Full Marks:** 45+30  
**Pass Marks:** 22.5+15  
**Credit Hrs:** 3

### Course Description:

This course provides a general introduction to the concept of enterprise architecture and other relevant topics. It covers the meaning of enterprise architecture, the place and role of enterprise architecture in the overall organizational context, key constituting elements and core mechanisms of an EA practice, as well as the business value and benefits of using enterprise architecture in organizations. It focuses specifically on EA artifacts as the core elements of an EA practice.

### Course Objectives:

The main objective of this course is to give an overall and complete understanding of Enterprise architecture and its best practices.

### Course Contents:

Unit	Contents	Hour
<b>1</b> <b>(4 Hrs.)</b> <b>Introduction</b>	The Role of Information Technology in Modern Organizations	<b>0.5</b>
	Benefits and threats of IT in Organization	<b>0.5</b>
	Business Value of IT ( Organizations as Socio-Technical System)	<b>1</b>
	Business and IT alignment problem and solutions (Diversity of Actors Involved in Alignment Processes, Main Groups of Actors Involved in Alignment Processes, Miscommunication Between Actors as the Root Cause of Misalignment)	<b>1.5</b>
	Enterprise Architecture as a Solution	<b>0.5</b>
	<b>Reference: Chapter 1 of the textbook</b>	
<b>2</b> <b>(10 Hrs.)</b> <b>Enterprise</b> <b>Application</b> <b>Architecture</b>	<b>Concepts of enterprise architecture (3 Hrs.)</b>	
	What Is Enterprise Architecture? ( The Essence of Enterprise Architecture, Enterprise Architecture Is Different from Traditional Architecture , Domains of Enterprise Architecture)	<b>0.5</b>
	The Practice of Enterprise Architecture	<b>0.5</b>
	Enterprise Architecture Artifacts ( Informational Contents of Enterprise Architecture Artifacts, Duality of Enterprise Architecture Artifacts, Two Meanings of Enterprise Architecture Artifacts: Decisions and Fact, Two Lifecycles of	<b>1</b>



	Enterprise Architecture Artifacts: Permanent and Temporary, Examples of Enterprise Architecture Artifacts)	
	The Role of Architects in an Enterprise Architecture Practice (General Responsibilities of Architects, Architects as Developers of Enterprise Architecture Artifacts, Enterprise Architecture Artifacts, Architects and Other Actors)	<b>0.75</b>
	Architecture Functions in Organizations	<b>0.25</b>
<b>Reference: Chapter 2 of the textbook</b>		
<b>Roles and practice of enterprise architecture, Architecture Functions in Organizations, Historical origin and best modern practice (3 Hrs.)</b>		
	The Need for Enterprise Architecture	<b>0.25</b>
	Communication as the Cornerstone of Enterprise Architecture Practice	<b>0.5</b>
	Benefits of Practicing Enterprise Architecture	<b>0.5</b>
	What Organizations Practice Enterprise Architecture?	<b>0.25</b>
	The Historical Origin of Enterprise Architecture and Modern Best Practices	<b>0.5</b>
	What Enterprise Architecture Practice Is Not (Not a Purely Technical Planning, Not a One-Size-Fits-All Methodology, Not an Automated Planning, Not a Substitute for Competence, Not a Work of Dedicated Experts, Not a One-Time Planning Project, Not a Technology-Specific Practice, Not Enterprise Modeling, Not Enterprise Engineering, Not Systems Thinking, Not a Breakthrough Solution, Not an Implementation of Enterprise Architecture Frameworks)	<b>1</b>
<b>Reference: Chapter 3 of the textbook</b>		
<b>Enterprise Architecture Practice as City Planning, Enterprise Architecture Artifacts, The CSVLOD Model (4 Hrs.)</b>		
	Enterprise Architecture Practice as City Planning	<b>0.5</b>
	Six Types of Enterprise Architecture Artifacts and City Planning Documents (Considerations, Standards, Visions, Landscapes, Outlines, Designs)	<b>1.5</b>
	Relationship Between Different Types of Enterprise Architecture Artifacts	<b>1</b>
	Complementarity of Different Types of Enterprise Architecture Artifacts	<b>0.5</b>
	The CSVLOD Model of Enterprise Architecture	<b>0.5</b>
<b>Reference: Chapter 4 of the textbook</b>		
<b>3 (10 Hrs.)</b>	<b>The Dialog between Business and IT, Enterprise Architecture Uncertainty Principle (5 Hrs.)</b>	

<b>Process of Enterprise Architecture</b>	Problems with the Business Strategy as the Basis for Architectural Planning (Business Strategy Is Often Vague, Unknown or Merely Absent, Business Strategy Rarely Provides a Clear Direction for Information Technology, Business Strategy Is Often Unstable and Frequently Changes, Business Strategy Often Requires Strategy-Specific, Non-Reusable IT Systems, The Role of Business Strategy for Enterprise Architecture Practice)	<b>2</b>
	Key Discussion Points Between Business and IT Stakeholders (Operating Model, Business Capabilities, Specific Business Needs, Business Processes, Business Requirements)	<b>2</b>
	The Hierarchy of Key Discussion Point	<b>0.5</b>
	Enterprise Architecture Uncertainty Principle	<b>0.5</b>
	<b>Reference: Chapter 5 of the textbook</b>	
	<b>Processes Constituting Enterprise Architecture Practice, A High-Level Process View of Enterprise Architecture Practice (5 Hrs.)</b>	
	Three Processes Constituting Enterprise Architecture Practice (Strategic Planning, Initiative Delivery, Technology Optimization)	<b>1.5</b>
	Relationship Between Different EA-Related Processes ( Strategic Planning and Initiative Delivery, Initiative Delivery and Technology Optimization, Technology Optimization and Strategic Planning)	<b>2</b>
	A High-Level Process View of Enterprise Architecture Practice	<b>1.5</b>
	<b>Reference: Chapter 6 of the textbook</b>	
<b>4 (15 Hrs.) The CSVLOD Model of Enterprise Architecture</b>	<b>Dimensions for Classifying Enterprise Architecture Artifacts (1 Hrs.)</b>	
	Dimensions for Classifying Enterprise Architecture Artifacts (Dimension One: What, Dimension Two: How)	<b>0.25</b>
	Six General Types of Enterprise Architecture Artifacts (Considerations, Standards, Visions, Landscapes, Outlines, Designs)	<b>0.5</b>
	The Resulting CSVLOD Model of Enterprise Architecture	<b>0.25</b>
	<b>Reference: Chapter 8 of the textbook</b>	
	<b>Considerations as a General Type of Enterprise Architecture Artifacts (2 Hrs.)</b>	
	Considerations as a General Type of Enterprise Architecture Artifacts (Informational Contents, Development and Usage, Role and Benefits, Difference from the Adjacent Types)	<b>0.5</b>
	Specific Enterprise Architecture Artifacts Related to Considerations (Principles, Policies, Conceptual Data Models, Analytical Reports, Direction Statements)	<b>1</b>
	Additional Concerns Regarding Considerations	<b>0.5</b>

<b>Reference: Chapter 9 of the textbook</b>	
<b>Standards as a General Type of Enterprise Architecture Artifacts (2 Hrs.)</b>	
Standards as a General Type of Enterprise Architecture Artifacts ( Informational Contents, Development and Usage, Role and Benefits, Difference from the Adjacent Types)	<b>0.5</b>
Specific Enterprise Architecture Artifacts Related to Standards (Technology Reference Models, Guidelines, Patterns, IT Principles, Logical Data Models, Less Popular Enterprise Architecture Artifacts Related to Standards)	<b>1</b>
Additional Concerns Regarding Standards	<b>0.5</b>
<b>Reference: Chapter 10 of the textbook</b>	
<b>Visions as a General Type of Enterprise Architecture Artifacts (2 Hrs.)</b>	
Visions as a General Type of Enterprise Architecture Artifacts ( Informational Contents, Development and Usage, Role and Benefits, Difference from the Adjacent Types)	<b>0.5</b>
Specific Enterprise Architecture Artifacts Related to Visions (Business Capability Models, Roadmaps, Target States, Value Chains, Context Diagrams, Less Popular Enterprise Architecture Artifacts Related to Visions)	<b>1</b>
Additional Concerns Regarding Visions	<b>0.5</b>
<b>Reference: Chapter 11 of the textbook</b>	
<b>Landscapes as a General Type of Enterprise Architecture Artifacts (2 Hrs.)</b>	
Landscapes as a General Type of Enterprise Architecture Artifacts ( Informational Contents, Development and Usage, Role and Benefits, Difference from the Adjacent Types)	<b>0.5</b>
Specific Enterprise Architecture Artifacts Related to Landscapes (Landscape Diagrams, Inventories, Enterprise System Portfolios, IT Roadmaps, Less Popular Enterprise Architecture Artifacts Related to Landscapes)	<b>1</b>
Additional Concerns Regarding Landscapes (Avoiding the Misuse of Landscapes, Finding the Appropriate Level of Abstraction)	<b>0.5</b>
<b>Reference: Chapter 12 of the textbook</b>	
<b>Outlines as a General Type of Enterprise Architecture Artifacts (2 Hrs.)</b>	
Outlines as a General Type of Enterprise Architecture Artifacts ( Informational Contents, Development and Usage, Role and Benefits, Difference from the Adjacent Types)	<b>0.5</b>
Specific Enterprise Architecture Artifacts Related to Outlines (Solution Overviews, Options Assessments, Initiative Proposals, Less Popular Enterprise Architecture Artifacts Related to Outlines)	<b>1</b>
Additional Concerns Regarding Outlines	<b>0.5</b>

	<b>Reference: Chapter 13 of the textbook</b>	
	<b>Designs as a General Type of Enterprise Architecture Artifacts (2 Hrs.)</b>	
	Designs as a General Type of Enterprise Architecture Artifact ( Informational Contents, Development and Usage, Role and Benefits, Difference from the Adjacent Types)	<b>0.5</b>
	Specific Enterprise Architecture Artifacts Related to Designs (Solution Designs, Preliminary Solution Designs, Less Popular Enterprise Architecture Artifacts Related to Designs)	<b>1</b>
	Additional Concerns Regarding Designs	<b>0.5</b>
	<b>Reference: Chapter 14 of the textbook</b>	
	<b>Continuous Nature of the CSVLOD Taxonomy for EA Artifacts (2 Hrs.)</b>	
	Continuous Nature of the CSVLOD Taxonomy for EA Artifacts	<b>0.25</b>
	Mapping of Specific EA Artifacts to the CSVLOD Taxonomy	<b>0.25</b>
	Decision Paths of the EA-Enabled Strategy Execution (Typical Decision Path, Alternative Decision Paths, Enterprise Architecture Artifacts as Decision Points)	<b>0.5</b>
	Descriptive Nature of the CSVLOD Model of Enterprise Architecture	<b>0.25</b>
	Exceptions to the CSVLOD Model of Enterprise Architecture	<b>0.25</b>
	Enterprise Architecture on a Page	<b>0.25</b>
	<b>Reference: Chapter 15 of the textbook</b>	
<b>5 (6 Hrs.) Enterprise Architecture Practices</b>	<b>Architects in Enterprise Architecture Practice (1.5 Hrs.)</b>	
	General Skills and Qualities of Architects (Knowledge of Business and Information Technology, Effective Communication, Collaborative Attitude, Innovative Mindset, Systems Thinking)	<b>0.25</b>
	Five Common Archetypes of Architects (Solution Architects, Domain Architects, Business Area Architects, Enterprise Architects, Architecture Managers, The Hierarchy of Architecture Positions)	<b>0.75</b>
	Architecture Positions in the Organizational Context (Organizational Mapping of Architecture Positions, Process Mapping of Architecture Positions, Architects, Engagement Managers and Technical Designers)	<b>0.25</b>
	How to Become an Architect and Advance in the Career?	<b>0.25</b>
	<b>Reference: Chapter 16 of the textbook</b>	
	<b>Roles and Structure of Architecture Functions in Organizations (1.5 Hrs.)</b>	
	The Role of Architecture Functions in Organizations	<b>0.25</b>
	The Structure of Architecture Functions (Dependence on the Size of an Organization, Dependence on the	<b>0.5</b>

Degree of Decentralization, Architecture Functions in Especially Complex Organizations)	
Governance Mechanisms of Architecture Functions (The Role of Governance Committees and Procedures, Four Types of Governance Committees and Procedures, Exemption and Escalation Procedures, The Structure of Governance Committees)	<b>0.75</b>
<b>Reference: Chapter 17 of the textbook</b>	
<b>Modeling Languages for Enterprise Architecture (1.5 Hrs.)</b>	
Modeling Languages for Enterprise Architecture (ArchiMate, Unified Modeling Language, Business Process Model and Notation, Architecture of Integrated Information Systems, Practical Applicability of Modeling Languages, The Role of Modeling Languages in Enterprise Architecture Practice)	<b>0.5</b>
Software Tools for Enterprise Architecture (Standard Applications of the Microsoft Office Suite, Specialized Software Tools for Enterprise Architecture, Configuration Management Databases, Practical Applicability of Software Tools, The Role of Software Tools in Enterprise Architecture Practice)	<b>0.5</b>
Measurements in Enterprise Architecture Practice (Measurements of the Quality of IT Investments, Measurements of the Magnitude of Technical Deviations, Measurements of the Complexity of the IT Landscape, The Use of Measurements in Enterprise Architecture Practice)	<b>0.5</b>
<b>Reference: Chapter 18 of the textbook</b>	
<b>Establishing Enterprise Architecture Practices in Organizations, Maturity of Enterprise Architecture Practice (1.5 Hrs.)</b>	
Establishing Enterprise Architecture Practices in Organizations (The Historical Path, The Deliberate Path, Facilitating the Organizational Acceptance of Enterprise Architecture Practice)	<b>0.5</b>
Maturity of Enterprise Architecture Practice (Problems with Assessing, Approaches for Assessing, Maturity of an EA Practice as a Factor of Sustainable Competitive Advantage)	<b>0.5</b>
Enterprise Architecture Practice and Enterprise Architecture Consulting (Initiative-Based Engagements, Strategic Engagements, Developmental Engagements, Productive and Counterproductive Relationships with Consultancies)	<b>0.5</b>
<b>Reference: Chapter 19 of the textbook</b>	

**Tribhuvan University**  
**Institute of Science and Technology**  
**Model Question**

**Master Level/ First Year/ First Semester**  
**Information Technology (MIT503)**  
**(Enterprise Application)**

**Full Marks: 45**  
**Pass Marks: 22.5**  
**Time: 2 hours**

**Section A**

**Attempt any two questions. [2 x 10 =20]**

1. What is enterprise architecture? Describe the essence of enterprise architecture. List the direct and indirect benefits of enterprise architecture. [2+5+3]
2. Consider you are an enterprise architect. Being the architect, describe the possible operating models with their capabilities that you can prescribe for the process standardization and data integration across the business units of an organization. [10]
3. Describe how analytical reports in Considerations EA artifact are prepared using hype cycles, technology radars, SWOT and vendor analyses. [10]

**Section B**

**Attempt any five questions. [5 x 5 =25]**

4. Discuss the main group of actors involved in business and IT alignment process. [5]
5. Describe how enterprise architecture practice is analogous to city planning. [5]
6. What is the technology optimization process? How insufficient involvement of relevant stakeholders in the corresponding EA-related processes leads to the “ivory tower” syndrome? [1.5+3.5]
7. Consider you are drafting Visions EA artifact, how will you define evolutionary target states and transformational target states to depict future state of an organization. Also present the schematic views of the states. [5]
8. Differentiate initiative based engagements from strategic engagements in EA consulting engagements. [5]
9. What is an architecture function? Describe the roles and responsibilities of architecture functions in an organization. [1+4]

## Information Security

**Course Title:** Information Security

**Course No:** MIT504

**Nature of the Course:** Theory + Lab

**Semester:** I

**Full Marks:** 45+30

**Pass Marks:** 22.5+15

**Credit Hrs:** 3

### Course Description:

This course introduces the concepts of information security. The topics covered include information security, cryptosystem, message authentication, digital signature, database and data center security, denial of service attack, intrusion detection, security administration, and digital forensics.

### Course Objectives:

The main objective of this course is to make students familiar with the concepts of information security so that upon completion of the course students will be able to understand and use the best practices for securing information and computer systems.

### Course Contents:

Unit	Contents	Hour
<b>1</b> <b>(4 Hrs.)</b> <b>Information Systems Security</b>	Information Systems Security <ul style="list-style-type: none"> <li>▪ Compliance Laws and Regulation Need for ISS</li> <li>▪ Risk, Threats and Vulnerabilities</li> </ul>	<b>2</b>
	Tenets of Information Systems Security	<b>1</b>
	Domains (7) of IT Infrastructures, IT Security Policy Framework, Data Classification Standards	<b>1</b>
<b>2</b> <b>(8 Hrs.)</b> <b>Private and Public Cryptosystem</b>	Block Ciphers AES <ul style="list-style-type: none"> <li>▪ Creating S-Box</li> <li>▪ Shift Rows, Mix Columns, Add round key, Next key generation</li> </ul>	<b>2</b>
	IDEA <ul style="list-style-type: none"> <li>▪ Round operation</li> <li>▪ Key schedule, Modulo operation</li> <li>▪ Example showing encryption on 16 bits plaintext</li> </ul>	<b>1</b>
	Stream Cipher, RC4 (with example), Stream Cipher using Feedback Shift Registers	<b>1</b>
	ElGamal Cryptosystem <ul style="list-style-type: none"> <li>▪ Algorithm, Encryption, Decryption</li> </ul> Elliptic Curve Cryptography <ul style="list-style-type: none"> <li>▪ Elliptic curve arithmetic (Abelian group, Galois field)</li> <li>▪ Finding points in Elliptic curve</li> <li>▪ Encryption algorithm</li> </ul>	<b>2.</b>
	Format Preserving Encryption, Overview of Homomorphic Encryption, Lightweight Cryptography	<b>1</b>
	Post Quantum Cryptography <ul style="list-style-type: none"> <li>▪ Quantum computing</li> </ul>	<b>1</b>

	<ul style="list-style-type: none"> <li>▪ Lattice Based Cryptographic algorithm</li> <li>▪ Code based cryptographic algorithm</li> </ul>	
<b>3</b> <b>(8 Hrs.)</b> <b>Message</b> <b>Authentication</b> <b>Codes and</b> <b>Digital</b> <b>Signature</b>	Message Authentication Code, HMAC, Data Authentication Algorithm, Cipher Based MAC	<b>1</b>
	Digital Signature <ul style="list-style-type: none"> <li>▪ Digital Signature Requirement</li> <li>▪ Direct Digital Signature</li> </ul>	<b>2</b>
	ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm	<b>2.5</b>
	RSA-PSS Digital Signature Algorithm <ul style="list-style-type: none"> <li>▪ Mask generation function</li> <li>▪ Signing operation</li> <li>▪ Signature verification</li> </ul>	<b>2.5</b>
<b>4</b> <b>(4 Hrs.)</b> <b>Database and</b> <b>Data Center</b> <b>Security</b>	Database security <ul style="list-style-type: none"> <li>▪ Abstract view of relation</li> <li>▪ Relational Database Elements</li> <li>▪ SQL</li> </ul>	<b>0.5</b>
	SQL Injection Attacks <ul style="list-style-type: none"> <li>▪ Typical Injection Attack</li> <li>▪ Sample SQL Injection</li> <li>▪ In-bands attack</li> </ul>	<b>1</b>
	Database Access Control <ul style="list-style-type: none"> <li>▪ Inferential Attack</li> <li>▪ Out-band Attack</li> <li>▪ SQLi countermeasures</li> <li>▪ SQL Access control</li> <li>▪ Cascading Authorizations</li> <li>▪ Role based Access control</li> </ul>	<b>1</b>
	Inference <ul style="list-style-type: none"> <li>▪ Inference example</li> <li>▪ Inference countermeasures</li> <li>▪ Statistical database</li> <li>▪ Protecting against inference</li> <li>▪ Perturbation</li> </ul>	<b>1</b>
	Database Encryption, Data Center Security	<b>0.5</b>
<b>5</b> <b>(6 Hrs.)</b> <b>Denial of</b> <b>Service Attacks</b>	Denial Service Attacks, Flooding Attacks	<b>0.5</b>
	Distributed Denial Service Attacks <ul style="list-style-type: none"> <li>▪ Bandwidth Attack</li> <li>▪ Protocol Attack</li> <li>▪ Software Vulnerability Attack</li> </ul>	<b>2</b>
	Application Based Bandwidth Attacks <ul style="list-style-type: none"> <li>▪ Ping Flood Attack</li> </ul>	<b>1.5</b>
	Reflector and Amplifier Attacks, Defensing Against Denial Service	<b>2</b>



	Attacks, Responding to Denial Service Attacks	
<b>6</b> <b>( 6 Hrs.)</b> <b>Intrusion</b> <b>Detection and</b> <b>Prevention</b>	Intruders, Intrusion Detection, Intrusion Detection Analysis Approaches, Host-Based Intrusion Detection	<b>2</b>
	Network-Based Intrusion Detection <ul style="list-style-type: none"> <li>▪ Anomaly Based IDS</li> <li>▪ Signature based IDS</li> </ul>	<b>2</b>
	Hybrid Intrusion Detection, Intrusion Detection Exchange Format, Honeypots, Intrusion Prevention System	<b>2</b>
<b>7</b> <b>(5 Hrs.)</b> <b>Security</b> <b>Operations and</b> <b>Administrations</b>	Security Administration <ul style="list-style-type: none"> <li>▪ Controlling access</li> <li>▪ Documentation</li> <li>▪ procedure and guidelines</li> <li>▪ Security outsourcing</li> </ul>	<b>1.5</b>
	Compliance Professional Ethics <ul style="list-style-type: none"> <li>▪ Common fallacies about ethics</li> <li>▪ code of ethics</li> </ul>	<b>1.5</b>
	Infrastructure for IT Security Policy, Data Classification Standards, Configuration Management, Change Management Process, Application Software Security, Software Development and Security	<b>2</b>
<b>8</b> <b>(4 Hrs.)</b> <b>Digital</b> <b>Forensics</b>	Digital Forensics <ul style="list-style-type: none"> <li>▪ Understanding digital forensics</li> <li>▪ Knowledge needed for Digital Forensics</li> </ul>	<b>2</b>
	Computer Crime, Forensic Methods and Lab, Collecting, Seizing and Protecting Evidence, Recovering Data, Operating System Forensics, Mobile Forensics	<b>2</b>

### **Laboratory Works:**

Laboratory works include implementing and simulating the concepts in above mentioned chapters using appropriate platforms and tools

### **References:**

1. David Kim, Michael G. Solomon, Fundamentals of Information Systems Security, 4th Edition, Jones & Bartlett Learning
2. William Stallings, Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson
3. William Stallings and Lawrie Brown, Computer Security: Principles and Practice, 4th Edition, Pearson

**Tribhuvan University**  
**Institute of Science and Technology**  
**Model Question**

**Master Level/ First Year/ First Semester**  
**Information Technology (MIT504)**  
**(Information Security)**

**Full Marks: 45**  
**Pass Marks: 22.5**  
**Time: 2 hours**

**Section A**

**Attempt any two questions. [2 x 10 =20]**

1. Define risks, threats and vulnerabilities. What is database access control? How do you prevent SQL injection attack? [3 + 3 + 4]
2. Explain the significances of Quantum cryptography. Generate the value of {AB} in S-Box. [1 + 9]
3. How digital signature is created and verified? Given the plain text 1100 0011 1010 1111 and keys 0000 1011 0000 1111 1010 0011, show the one round operation in IDEA. [2 + 8]

**Section B**

**Attempt any five questions. [5 x 5 =25]**

4. What is computer crime? What are the methods for collecting, seizing and protecting evidences? [1+4]
5. Describe the infrastructure for IT security policy. [5]
6. What might be the methods to defense against denial service attacks? Explain. [5]
7. Discuss the types of IDS? [5]
8. Explain any five domains of IT infrastructure. [5]
9. Describe the encryption method for IDEA algorithm. [5]

**Course Title:** Programming Language  
**Course No:** MIT505  
**Nature of the Course:** Theory + Practical  
**Semester:** I

**Full Marks:** 45+30  
**Pass Marks:** 22.5+15  
**Credit Hrs:** 3

**Course Description:**

This course covers basics and of procedural and object oriented aspects of python programming language and also covers detailed discussion on using various libraries their applications in various data processing tasks.

**Course Objectives:**

The main objective of this course is to provide knowledge of procedural and object oriented programming using python programming and apply it in data processing tasks.

**Course Contents:**

Unit	Contents	Hour
<b>1</b> <b>(12 Hrs.)</b> <b>Procedural</b> <b>Python</b>	<b>Tokens:</b> Reserved Words, Identifier, Data types, variables and Constants, Literals, Operators, Operator Precedence, Escape sequences, Numbers, Comments.	<b>2</b>
	<b>Control Flow:</b> Conditional statements, Ternary operator, Loops, Jump statements.	<b>1</b>
	<b>Functions:</b> Defining and Calling Functions, Passing Arguments, Passing Variable Number of Arguments, Returning values, Returning Objects, Returning Multiple Values, Global and Local variables, Global Keyword, Recursive functions, anonymous functions or Lambda expressions and other Functional Tools (map, filter and reduce).	<b>4</b>
	<b>Strings:</b> String Functions, String Concatenation, String operations, String slicing, string formatters.	<b>2</b>
	<b>Data Structures:</b> Working with Lists, Tuples, Sets, and Dictionaries. Functions, methods, and operations of each data structure, List Comprehension, Zip and Argument Unpacking.	<b>3</b>
<b>2</b> <b>(10 Hrs.)</b> <b>Object</b> <b>Oriented</b> <b>Python</b>	Class, Object, instance and class variables, instance, class and static methods.	<b>3</b>
	Constructors, access modifiers.	<b>1</b>
	Method overloading, operator overloading.	<b>1</b>
	Inheritance, method overriding, abstract classes.	<b>2</b>
	Enumerations, Exception Handling, File Handling.	<b>2</b>

	Regular Expressions.	<b>1</b>
<b>3</b> <b>(10 Hrs.)</b> <b>Libraries</b>	<b>NumPy:</b> NumPy Basics, Array and vectorized processing, operations between arrays and scalars, slicing and indexing, multi-dimensional array, Universal Functions, data processing with arrays, array object, array functions, File input and output with arrays, Linear Algebra with arrays, random number generation.	<b>4</b>
	<b>Pandas:</b> Pandas Data structure, Essential Functionalities, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing, Integer Indexing and Panel Data.	<b>3</b>
	<b>Matplotlib:</b> Introduction, Plotting Functions in pandas, Plotting Maps, Python Visualization Tool Ecosystem.	<b>3</b>
<b>4</b> <b>(13 Hrs.)</b> <b>Data Processing</b>	<b>Data Loading, Storage, and File Formats:</b> Reading and Writing Data in Text Format, Binary Data Formats, Interacting with HTML and Web APIs, Interacting with Databases.	<b>5</b>
	<b>Data Wrangling:</b> Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String Manipulation.	<b>4</b>
	<b>Data Aggregation and Group Operations:</b> GroupBy Mechanics, Data Aggregation, Group-wise Operations and Transformations, Pivot Tables and Cross-Tabulation.	<b>4</b>

### Laboratory Works:

Students need to write python programs using procedural as well as object oriented approach. Besides, they need to use various libraries discussed in the class and solve various data processing problems

### References:

1. AMZ Press, Python Programming for Beginners: The Ultimate Guide for Beginners to Learn Python Programming: Crash Course on Python Programming for Beginners, Independently published, First Edition, 2022
2. Abhishek Singh, Master Python Programming: Learn Python like Never Before, independently published, First Edition, 2022
3. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, 2<sup>nd</sup> Edition, 2017
4. Daniel Zingaro, Learn to Code by Solving Problems: A Python Programming Primer, No Starch Press, First Edition, 2021

5. Codeone Publishing, Python Programming for Beginners: The #1 Python Programming Crash Course to Learn Python Coding Well and Fast (with Hands-On Exercises), First Edition, 2022

**Tribhuvan University**  
**Institute of Science and Technology**  
**Model Question**

**Master Level/ First Year/ First Semester**  
**Information Technology (MIT505)**  
**(Programming Language)**

**Full Marks: 45**  
**Pass Marks: 22.5**  
**Time: 2 hours**

**Section A**

**Attempt any two questions. [2 x 10 =20]**

1. How function can be used to send, receive and return multiple values? [10]  
Demonstrate with examples of each.
2. Write a python program to create class Account with data members account number, account name, and balance. Add members function for reading and displaying data. Derive class saving account from account class. Add class variable minimum balance in the class. Define member functions deposit, withdraw, transfer, displayMinBalance (non-instance member function), and verify (static member function) in the class. Method verify should verify the amount at the time of withdraw and transfer operation. Finally, create an object of saving account class and demonstrate all operations defined in the class. [10]
3. What are two major data structures available in pandas? Demonstrate briefly. [10]  
How can you handle missing values in pandas data frame? Demonstrate with suitable code snapshots.

**Section B**

**Attempt any five questions. [5 x 5 =25]**

4. Write a python programs to read 10 elements in a list from users and then use list comprehension to find and display odd and even numbers in the list. [5]
5. How can you validate data using regular expression? WAP to validate cell number such that the cell number should exactly contain 10 digits. [5]
6. Write a python program to read elements of two matrices, convert them to NumPy arrays, and then find and display element wise multiplication, matrix multiplication and transpose of matrix. [5]
7. Explain the concept of data discretization? How discretization can be performed using python? Demonstrate with example. [5]
8. Discuss group by mechanics? How can you perform group by operations using one or two attributes of data frame? Demonstrate with suitable python program. [5]
9. Write brief notes on matplotlib API? How it can be used to draw bar graphs and scatterplots? Explain with examples. [5]