

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

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**Masters in Information Technology (MIT)**  
**Course Structure**

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**Prepared by**  
**Computer Science and Information Technology Subject**  
**Committee**

**Introduction:**

The Masters in Information Technology (MIT) curriculum is designed by closely following the courses practiced in accredited international universities, subject to the condition that the intake students are mostly from Bachelor in Masters in Information Technology, Computer Science, Computer Engineering, Computer Application, Information Management, or Information Systems. The Masters in Information Technology (MIT) provides the knowledge, understanding and research skills to solve real-world problems with cutting-edge technology. The MIT program avails to develop deep theoretical and practical knowledge in specific areas of information technology so that MIT graduates will have the intellectual and conceptual foundation to play leading roles in the development of the information technology industry. The MIT program curriculum covers the standard core and elective Information Technology courses. In addition, the program offers several courses that provide knowledge for both research and development information technology areas. The foundation and core courses are designed to meet the graduate program requirement, and the service courses are designed to meet the need of fast changing computer technologies and their application. All graduate students are required to complete at least 59 credit hours and they may complete maximum of 62 credit hours. The program is under Institute of Science and Technology (IOST).

**Objective:**

The main objective of MIT program is to deliver comprehensive education in principles and practices on information technology so to provide students' depth knowledge and research skills in the information technology domain including theories, programming practices, and application of computers.

**Admission Requirement:**

The student entering the MIT program must have completed Bachelor of Information Technology degree offered by TU or its equivalent. Prospective student can apply for admission by submitting a completed form as required by the general rule of the university. The students for admission are selected based on the scores in the entrance test conducted by the admitting college. The program also admits students having Bachelor of Computer Science, Bachelor of Computer Science and Information Technology, Bachelor of Information Technology, Bachelor

of Engineering in Computer and Electronics, Bachelor of Information Management, Bachelor of Information Systems, Bachelor of Computer Application of their equivalent.

### **Evaluation:**

All the courses, seminar, Literature Review Research, and Project/ Thesis should have internal weightage of 40% and external weightage of 60%. A student should secure minimum of 50% in overall weightage to pass a course. The final grade point in each course will be the sum of overall weightage of in all categories.

The Seminar, Literature Review Research, and Project/Thesis are evaluated by different evaluators. To pass these, students should secure at least 50% marks in the evaluation of each evaluator and the final grade point will be the sum of all the evaluations. For the evaluation of final presentations, an external examiner will be assigned.

### **Grading System:**

The grade awarded to each student in each course is based on his/her overall performance through internal and external evaluations. Several evaluation criteria are used for the continuous internal evaluation. External evaluation is solely based on examination conducted by Institute of Science and Technology (IoST). The grade in each course is assigned using a letter grade that indicates the overall performance of each student in each course. The chart below represents letters with its corresponding grading scale, grade point, and performance remarks.

Letter Grade	Grading Scale	Grade Point	Performance Remarks
A	90-100	4	Distinction
A <sup>-</sup>	80 – less than 90	3.7	Very Good
B <sup>+</sup>	70 – less than 80	3.3	First Division
B	60 – less than 70	3	Second Division
B <sup>-</sup>	50 – less than 60	2.7	Pass in individual subject
F	0 – less than 50	0	Fail

The performance of each student in each semester shall be evaluated in terms of Semester Grade Point Average (SGPA) which is the grade point average for the semester. SGPA is calculated as

$$\text{SGPA} = \frac{\text{Total Grade Points earned in a Semester}}{\text{Total number of credits earned in the semester}}$$

The cumulative grade point average (CGPA) is the grade point average for all completed semesters. CGPA is calculated as

$$\text{CGPA} = \frac{\text{Total Grade Points earned}}{\text{Total number of credits completed}}$$

### **Final Examination:**

Institute of Science and Technology, Tribhuvan University, will conduct the final examination at the end of each semester for each course except Seminar, Literature review research, and Project/Thesis. The weightage of this final examination is 60% of the overall weightage.

### **Course Structure:**

#### **Semester I**

<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>	<b>Full Marks</b>
MIT501	Object Oriented Analysis and Design	3	75
MIT502	Advanced Database System	3	75
MIT503	Enterprise Applications	3	75
MIT504	Information Security	3	75
MIT505	Programming Language	3	75
Total		15	375

#### **Semester II**

<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>	<b>Full Marks</b>
MIT551	Distributed and Cloud Computing	3	75
MIT552	Digital Marketing	3	75
MIT553	IT Project Management	3	75
MIT554	Intelligent Computing	3	75
MIT555	Seminar	1	25

	Elective I	3	75
Total		16	400

**List of Electives:**

1. Internet of Things (MIT556)
2. Data Structures and Algorithms Analysis (MIT557)
3. E-commerce and E-business (MIT558)
4. Advanced Programming (MIT559)

**Semester III**

Course Code	Course Title	Credit Hours	Full Marks
MIT601	Cybersecurity and Digital Forensics	3	75
MIT602	Data Analytics and Visualization	3	75
MIT603	Digital Governance	3	75
MIT554	Term Paper	2	50
	Elective II	3	75
Total		14	350

**List of Electives:**

1. Digital Economy (MIT605)
2. Mobile Computing (MIT606)
3. Human Computer Interaction (MIT607)
4. Database Administration (MIT608)

**Semester IV**

Course Code	Course Title	Credit Hours	Full Marks
MIT651	IT Entrepreneurship and Innovation	3	75
MIT652	Thesis/Project	8	200
	Elective III	3	75
	Extra Elective	3	75
Total		14	350

**List of Electives/Extra Electives:**

1. Social Network Analytics (MIT653)
2. Software Testing (MIT654)
3. Network and System Administration (MIT655)
4. Web Technology (MIT656)
5. International Business (MIT657)

## 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 1: Introduction (9 Hrs.)

Introduction; Roles and Skills of Systems Analyst; Systems Development Life Cycle; Systems Development Methodologies – Structured Design, Rapid Application Development, Object-Oriented Systems Analysis and Design, Agile Development, DevOps, Custom Methodologies; Unified Process; Unified Modeling Language; Basic Characteristics of Object-Oriented Systems

#### Unit 2: Analysis Modeling (18 Hrs.)

**Requirements Determination:** Introduction; Requirements Determination; Requirements Analysis Approaches; Requirements Gathering Techniques; Text Analysis; Requirements Definition; System Proposal

**Business Process and Functional Modeling:** Introduction; Business Process Modeling with Use Case Diagrams and Activity Diagrams; Business Process Identification with Use Cases and Use-Case Diagram; Business Process Documentation with Use-Case Descriptions; Verifying and Validating Business Process and Functional Models

**Structural Modeling:** Introduction; Structural Models; Object Identification; CRC Cards; Class Diagrams; Structural Models using CRC Cards and Class Diagrams; Verifying and Validating Structural Models

**Behavioral Modeling:** Introduction; Behavioral Models; Interaction Diagrams; CRUDE Analysis; Behavioral State Machines; Verifying and Validating Behavioral Models

#### Unit 3: Design Modeling (12 Hrs.)

**Moving on to Design:** Introduction; Verifying and Validating Analysis Models; Evolving Analysis Models into Design Models; Packages and Package Diagrams; Design Criteria and Strategies; Selecting Acquisition Strategy

**Class and Method Design:** Introduction; Object Design Activities; Constraints and Contracts; Method Specification; Verifying and Validating Class and Method Design

**Data Management Layer Design:** Introduction; Object Persistence Formats; Mapping Problem Domain Objects to Object Persistence Formats; Designing Data Access and Manipulation Classes; Nonfunctional Requirements and Data Management Layer Design; Verifying and Validating Data Management Layer

**Human Computer Interaction Layer Design:** Introduction; Principles for User Interface Design; User Interface Design Process; Navigation Design; Input and Output Design; International and Cultural Issues and User Interface Design; Nonfunctional Requirements and Human Computer Interaction Layer

**Physical Architecture Layer Design:** Introduction; Elements of Physical Architecture layer; Infrastructure Design; Hardware and System Software Specifications; Nonfunctional Requirements and Physical Architecture Layer Design; Verifying and Validating Physical Architecture Layer

**Unit 4: Construction, Installation, and Operation (6 Hrs.)**

**Construction:** Introduction; Managing Programming; Developing Documentation; Designing Tests

**Installation and Operation:** Introduction; Cultural Issues and IT Adoption; Conversion; Change Management; Post Implementation Activities

**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

## **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 1: Object and Object-Relational Databases (5 Hrs.)**

Overview of Object-Oriented concepts; Object database extension to SQL; The ODMG object model and the Object Definition Language (ODL); Object Database Conceptual Design; The Object Query Language (OQL)

#### **Unit 2: Query Processing and Optimization (11 Hrs.)**

Translating SQL Queries into Relational Algebra and Other Operators; Algorithms for External Sorting; Algorithms for SELECT Operation; Implementing the JOIN Operation; Algorithms for PROJECT and Set Operations; Implementing Aggregate Operations and Different types of JOINS; Combining Operations Using Pipelining; Parallel Algorithms for Query Processing: Operator Level, Intraquery, Interquery

Query Trees and Heuristics for Query Optimization; Choice of Query Execution Plans; Use of Selectivities in Cost-Based Optimization: Cost components for Query Execution, Catalog Information Used in Cost Functions, Histograms; Cost Functions for SELECT Operation; Cost Functions for the JOIN Operation; Additional Issues Related to Query Optimization; Query Optimization in Data Warehouses

#### **Unit 3: Distributed Database Concepts (7 Hrs.)**

Distributed Database Concepts; Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design; Overview of Concurrency Control and Recovery in Distributed Databases; Overview of Transaction Management in Distributed Databases; Query Processing and

Optimization in Distributed Databases; Types of Distributed Database Systems; Distributed Database Architectures; Distributed Catalog Management

**Unit 4: NOSQL Databases and Big Data Storage Systems (6 Hrs.)**

Introduction to NOSQL Systems; Characteristics of NOSQL System, Categories of NOSQL Systems, The CAP Theorem; Document-Based NOSQL Systems and MongoDB; NOSQL Key-Value Stores; Column-Based or Wide Column NOSQL Systems; NOSQL Graph Databases and Neo4j

**Unit 5: Big Data Technologies Based on MapReduce and Hadoop (5 Hrs.)**

Introduction to Big Data; Introduction to MapReduce and Hadoop; Hadoop Distributed File System (HDFS); MapReduce Runtime; Joins in MapReduce, Apache Hive, YARN

**Unit 6: Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases (5 Hrs.)**

Active Database Concepts and Triggers; Temporal Database Concepts; Spatial Database Concepts; Multimedia Database Concepts; Introduction to Deductive Databases

**Unit 7: Introduction to Information Retrieval and Web Search (6 Hrs.)**

Information Retrieval Concepts; Retrieval Models, Types of Queries in Information Retrieval Systems; Text Preprocessing; Inverted Indexing; Evaluation Measures of Search Relevance; Web Search and Analysis; Trends in Information Retrievals

**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

## **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 1: Introduction (4 Hrs.)**

The Role of Information Technology in Modern Organizations, Benefits and threats of IT in organization, Business Value of IT, Business and IT alignment problem and solutions

#### **Unit 2: Enterprise Application Architecture (10 Hrs.)**

Concepts of enterprise architecture, Roles and practice of enterprise architecture, Architecture Functions in Organizations, Historical origin and best modern practices, Enterprise Architecture Practice as City Planning, Enterprise Architecture Artifacts, The CSVLOD Model

#### **Unit 3: Process of Enterprise Architecture (10 Hrs.)**

The Dialog between Business and IT, Enterprise Architecture Uncertainty Principle, Processes Constituting Enterprise Architecture Practice, A High-Level Process View of Enterprise Architecture Practice

#### **Unit 4: The CSVLOD Model of Enterprise Architecture (15 Hrs.)**

Dimensions for Classifying Enterprise Architecture Artifacts, Considerations as a General Type of Enterprise Architecture Artifacts, Standards as a General Type of Enterprise Architecture Artifacts, Visions as a General Type of Enterprise Architecture Artifacts, Landscapes as a General Type of Enterprise Architecture Artifacts, Outlines as a General Type of Enterprise Architecture Artifacts, Designs as a General Type of Enterprise Architecture Artifacts, Continuous Nature of the CSVLOD Taxonomy for EA Artifacts

#### **Unit 5: Enterprise Architecture Practices (6 Hrs.)**

Architects in Enterprise Architecture Practice, Roles and Structure of Architecture Functions in Organizations, Modeling Languages for Enterprise Architecture, Establishing Enterprise Architecture Practices in Organizations, Maturity of Enterprise Architecture Practice

**Laboratory Works:**

Students are required to prepare a case study for any of the recent enterprise application framework used in an organization.

**References:**

1. Svyatoslav Kotusev - The Practice of Enterprise Architecture, A Modern Approach to Business and IT Alignment-SK Publishing (2021)

## **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 1: Information Systems Security (4 Hrs.)**

Information Systems Security, Tenets of Information Systems Security, Domains of IT Infrastructures, IT Security Policy Framework, Data Classification Standards

#### **Unit 2: Private and Public Cryptosystem (8 Hrs.)**

Block Ciphers, AES, IDEA, Stream Ciphers, RC4, Stream Cipher using Feedback Shift Registers, ElGamal, Elliptic Curve Cryptography, Format Preserving Encryption, Overview of Homomorphic Encryption, Lightweight Cryptography and Post Quantum Cryptography

#### **Unit 3: Message Authentication Codes and Digital Signature (8 Hrs.)**

Message Authentication Code, HMAC, Data Authentication Algorithm, Cipher Based MAC, Digital Signature, ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm

#### **Unit 4: Database and Data Center Security (4 Hrs.)**

Database Security, SQL Injection Attacks, Database Access Control, Inference, Database Encryption, Data Center Security

#### **Unit 5: Denial of Service Attacks (6 Hrs.)**

Denial Service Attacks, Flooding Attacks, Distributed Denial Service Attacks, Application Based Bandwidth Attacks, Reflector and Amplifier Attacks, Defending Against Denial Service Attacks, Responding to Denial Service Attacks

**Unit 6: Intrusion Detection and Prevention (6 Hrs.)**

Intruders, Intrusion Detection, Intrusion Detection Analysis Approaches, Host-Based Intrusion Detection, Network-Based Intrusion Detection, Hybrid Intrusion Detection, Intrusion Detection Exchange Format, Honeypots, Intrusion Prevention System

**Unit 7: Security Operations and Administrations (5 Hrs.)**

Security Administration, Compliance, Professional Ethics, Infrastructure for IT Security Policy, Data Classification Standards, Configuration Management, Change Management Process, Application Software Security, Software Development and Security

**Unit 8: Digital Forensics (4 Hrs.)**

Digital Forensics, Computer Crime, Forensic Methods and Lab, Collecting, Seizing and Protecting Evidence, Recovering Data, Operating System Forensics, Mobile Forensics

**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, 8<sup>th</sup> Edition, Pearson
3. William Stallings and Lawrie Brown, Computer Security: Principles and Practice, 4<sup>th</sup> Edition, Pearson

## Programming Language

**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 1: Procedural Python (12 Hrs.)

Tokens, Reserved Words, Identifier, Data types, variables and Constants, Literals, Operators, Operator Precedence, Escape sequences, Numbers, Comments, Control Flow: Conditional statements, Ternary operator, Loops, Jump statements. Functions: Defining and Calling Functions, Passing Arguments, Returning values, Global and Local variables, Recursive functions, anonymous functions, Lambda expressions. Strings: String Functions, String Concatenation, String operations, String slicing, string formatters; Working with Lists, Tuples, Sets, and Dictionaries; Functions, methods, and operations of each data structure

#### Unit 2: Object Oriented Python (10 Hrs.)

Class, Object, constructors, access modifiers, static methods, method overloading, operator overloading, inheritance, method overriding, abstract classes; Enumerations, Exception Handling, File Handling, Regular Expressions

#### Unit 3: Libraries (10 Hrs.)

NumPy: NumPy Basics, Array and vectorized processing, operations between arrays and scalars, slicing and indexing, multi-dimensional array, data processing with arrays, array object, array functions, File input and output with arrays, Linear Algebra with arrays, random number generation; Pandas: Pandas Data structure, Essential Functionalities, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing; Matplotlib: Introduction, Plotting Functions in pandas, Plotting Maps, Python Visualization Tool Ecosystem

#### Unit 4: Data Processing (13 Hrs.)

Data Loading, Storage, and File Formats: Reading and Writing Data in Text Format, Reading and Writing Data in Binary Data Formats, Interacting with HTML and Web APIs, Interacting with Databases; Data Wrangling: Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation; Data Aggregation and Group Operations: GroupBy Mechanics, Data Aggregation, Group-wise operations and Transformations, Pivot Tables and Cross-Tabulation

### 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, 2 ,Reilly Media'O<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

## **Distributed and Cloud Computing**

**Course Title:** Distributed and Cloud Computing  
**Course No:** MIT551  
**Nature of the Course:** Theory + Lab  
**Semester:** II

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

### **Course Description:**

The course introduces the concepts of distributed and cloud computing including cloud computing, cloud service models, parallel and distributed computing, cloud networks, cloud resource management and scheduling, concurrency in cloud and emerging concepts in cloud.

### **Course Objectives:**

The main objective of this course is to make students familiar with the concepts of distributed and cloud computing so that upon completion of the course students will be able to use and develop the distributed and cloud computing models.

### **Course Contents:**

#### **Unit 1: Introduction (4 Hrs.)**

Cloud Computing, Impact of Cloud Computing, Ethical Issues in Cloud Computing, Factors affecting Cloud Computing Service Availability, Network Centric Computing and Network Centric Content, Virtualization and Cloud Computing, Types of Virtualization

#### **Unit 2: Cloud Ecosystem (6 Hrs.)**

Cloud Computing Delivery Models and Services, AWS, Google Clouds, Azure, IBM Clouds, Cloud Storage Diversity and Vendor Lock-In, Cloud Interoperability, Service and Compliance Level Agreements, User Challenges and Experience, Challenges in Cloud Computing

#### **Unit 3: Parallel and Distributed Computing (5 Hrs.)**

Introduction to Parallel and Distributed Computing, Elements of Parallel Computing, Elements of Distributed Computing, Technologies for Distributed Computing

#### **Unit 4: Cloud Access and Cloud Interconnection Networks (9 Hrs.)**

Packet Switched Network and Internet, TCP Congestion Control, Content Centric Network, Software Defined Networks, Interconnection Networks for Computer Clouds, Multistage Interconnection Networks, Storage Area Networks and Fiber Channel, Scalable Data Center Communication Architectures, Network Resource Management Algorithms (Fair Queuing, Class-Based Queuing), Content Delivery Networks, Vehicular Ad Hoc Networks

#### **Unit 5: Cloud Resource Management and Scheduling (10 Hrs.)**

Policies and Mechanisms for Resource Management, Scheduling Algorithms for Computer Clouds, Delay Scheduling, Data-Aware Scheduling, Apache Capacity Scheduler, Start-Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Resource Bundling and Combinatorial Auctions for Cloud Resources, Resource Management and Dynamic Application Scaling, Control Theory and Optimal Resource Management, Two Level Resource Allocation

Architecture, Feedback Control on Dynamic Thresholds, Autonomic Performance Managers, Utility Model for Cloud-Based Web Services

**Unit 6: Concurrency and Cloud Computing (8 Hrs.)**

Concurrency, Communication and Concurrency, Computational Models, Communicating Sequential Processes, Bulk Synchronous Parallel Model, Model for Multicore Computing, Modeling Concurrency with Petri Nets, Process State, Communication Protocols and Process Coordination, Logical Clocks and Message Delivery Rules, Runs and Cuts, Threads and Activity Coordination, Critical Sections, Locks, Deadlocks, Atomic Actions, Consensus Protocol, Load Balancing

**Unit 7: Emerging Clouds (3 Hrs.)**

Machine Learning on Clouds, Quantum Computing on Clouds, Vehicular Clouds

**Laboratory Works:**

The laboratory work should include the implementation and simulation of the concepts in above mentioned units using appropriate platforms and tools.

**References:**

1. Dan C. Marinescu, Cloud Computing Theory and Practice, 3<sup>rd</sup> Edition, Morgan Kaufmann Publishers, 2022
2. Raj Kumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, Morgan Kaufmann Publishers

## Digital Marketing

**Course Title:** Digital Marketing  
**Course No:** MIT552  
**Nature of the Course:** Theory + Practical  
**Semester:** II

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

### Course Description:

This course introduces the concepts of digital marketing. The course contains concepts and structures of digital marketing types, tools and analytical aspect digital marketing. This course also highlights various types different digital marketing metrics.

### Course Objectives:

Upon completion of the course, students should be able to:

1. Understand concepts of digital marketing and differentiate it from traditional marketing
2. Plan and execute digital marketing strategies in real world scenarios
3. Use various method of digital marketing effectively for real world scenarios
4. Understand concept of lead generation and lead funnel

### Course Contents:

#### Unit 1: Introduction to Digital Marketing (2 Hrs.)

Defining digital marketing, traditional marketing vs. digital marketing, relevance of digital marketing, the 3i principle

#### Unit 2: Search Engine Marketing and Optimization (12 Hrs.)

Techniques to generate website traffic, Techniques used to increase the visibility of webpage on Google search resultpage (SERP), Positioning in SERP, On-page optimization, Off-page optimization, Pay per click, Google AdWords

#### Unit 3: Social Media Marketing (10 Hrs.)

Types, forms and stakeholders of SMM, Understanding the right fit, various SMM Strategies, Analysis of social media

#### Unit 4: Web Analytics (6 Hrs.)

Analyzing the behavior of visitors to a website through reports based on traffic sources, referring sites, page views, and conversion rates of that website, Google Analytics concept, setup, monitoring and analyzing

#### Unit 5: Email Marketing (4 Hrs.)

Email marketing process, Design and contents, Delivery and Discovery of email marketing

#### Unit 6: Strategy and Planning (4 Hrs.)

Digital marketing plan and structure, Identification of tools and audience, defining objectives and activities, Analysis and ROI

**Unit 8: Content Marketing (5 Hrs.)**

Definition, history, and need of content marketing, Business model and cases of content marketing, Epic content marketing

**Unit 7: Affiliate Marketing (2 Hrs.)**

Concepts and examples of affiliate marketing

**Laboratory Works:**

Lab works includes on page and off page optimization of a particular website using various tools, hands on sessions of social media marketing with lead generation and ppc and google analytics setup, monitoring and analysis.

**References:**

1. Ian Dodson - The art of digital marketing the definitive guide to creating strategic, targeted and measurable online campaigns (2016), Wiley
2. Russ Henneberry& Ryan Deiss, Digital Marketing for Dummies, 2<sup>nd</sup> Edition, John Wiley & Sons, Inc.
3. Pulizzi, Joe, Epic content marketinghow to tell a different story, break through the clutter, and win more customers by marketing less-McGraw-Hill Education (2014)

## **IT Project Management**

**Course Title:** IT Project Management  
**Course No:** MIT553  
**Nature of the Course:** Theory + Lab  
**Semester:** II

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

### **Course Description:**

This course familiarizes students with the concepts of managing IT projects in a systemic manner using various project management concepts. This course focuses on evaluation, estimation, planning, risk management, managing people, managing contract and quality.

### **Course Objectives:**

By the end of this course, students will be able to use various project management skills while developing IT projects. They will also be able to manage stakeholders and maintain quality of the project.

### **Course Contents:**

#### **Unit 1: Introduction to Software Project Management (4 Hrs.)**

Introduction; Why is Software Project Management Important; What is a Project; Software Projects versus Other Types of Project; Contract Management and Technical Project Management; Activities Covered by Software Project Management; Plans, Methods and Methodologies; Some Ways of Categorizing Software Projects; Stakeholders; Setting Objectives; Project Success and Failure; What is Management; Management Control; Traditional versus Modern Project Management Practices

#### **Unit 2: Project Evaluation and Program Management (5Hrs.)**

Introduction; Project Portfolio Management; Evaluation of Individual Projects; Cost–benefit Evaluation Techniques; Risk Evaluation; Program Management; Managing the Allocation of Resources within Program; Strategic Program Management

#### **Unit 3: An Overview of Project Planning and modern project approaches (3 Hrs.)**

Introduction; Detail steps of Project Planning; Agile Methods; Extreme Programming (XP); Scrum; Managing Iterative Processes

#### **Unit 4: Software Effort Estimation (5 Hrs.)**

Introduction; Where are Estimates Done; Problems with Over- and Under-Estimates; the Basis for Software Estimating; Software Effort Estimation Techniques; Bottom-up Estimating; The Top-down Approach and Parametric Models; Expert Judgement; Estimating by Analogy; Function Points Mark II; COSMIC Full Function Points; COCOMO II: A Parametric Productivity Model; Cost Estimation

#### **Unit 5: Activity Planning (5 Hrs.)**

Introduction; Planning Objectives and timing; Project Schedules; Projects and Activities; Sequencing and Scheduling Activities; Network Planning Models; Formulating a Network Model; Adding the Time Dimension; The Forward Pass; The Backward Pass; Identifying the Critical Path;

Activity Float; Shortening the Project Duration; Identifying Critical Activities; Activity-on-Arrow Networks

**Unit 6: Risk Management (5 Hrs.)**

Introduction; Categories of Risk; A Framework for Dealing with Risk; Risk Identification; Risk Assessment; Risk Planning; Risk Management; Evaluating Risks to the Schedule; Applying the PERT Technique; Monte Carlo Simulation; Critical Chain Concepts

**Unit 7: Resource Allocation (4 Hrs.)**

Introduction; Identifying and Scheduling Resources; Publishing the Resource Schedule; The Scheduling Sequence

**Unit 8: Monitoring and Control (4 Hrs.)**

Introduction; Creating the Framework; Collecting the Data; Visualizing Progress; Earned Value Analysis ; Change Control; Software Configuration Management

**Unit 9: Managing Contracts (3 Hrs.)**

Introduction; Types of Contract; Stages in Contract Placement; Typical Terms of a Contract; Contract Management

**Unit 10: Managing People in Software Environments and working in teams (4 Hrs.)**

Introduction; The Oldham–Hackman Job Characteristics Model; Becoming a Team; Decision Making; Organization and Team Structures; Coordination Dependencies; Dispersed and Virtual Teams; Communication Genres; Communication Plans; Leadership

**Unit 11: Software Quality (3 Hrs.)**

Introduction; The Place and importance of Software Quality; Product and Process Metrics with respect to project management; Quality Management Systems; Process Capability Models

**Laboratory / Project Work:**

Students should be able to use different CASE tools regarding project management focusing on work breakdown structure, resource break down structure, estimation, software configuration management. The students should prepare a report on a case study focusing on cost benefit analysis, earned value analysis, risk analysis

**References:**

1. Software Project Management 5 edition; Tata McGraw Hill Education Private Limited; Bob Hughes, Mike Cotterell, Rajib Mall
2. Introduction to Software Project Management & Quality Assurance, Darrel Ince, I. Sharp, M. Woodman, Tata McGraw Hill
3. Software Project Management: A Unified Framework, Walker Royce, Addison-Wesley, An Imprint of Pearson Education

## **Intelligent Computing**

**Course Title:** Intelligent Computing  
**Course No:** MIT 554  
**Nature of the Course:** Theory + Lab  
**Semester:** II

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

### **Course Description:**

This course covers different concepts related with computational linguistics that can be applied for machine learning. The course will focus on the main computational intelligence approaches and methodologies, namely artificial neural networks, genetic algorithms, swarm optimization, and fuzzy systems.

### **Course Objectives:**

The main objective of this course is to provide fundamental knowledge on the concept of computational intelligence.

### **Unit 1: Introduction to Computational Intelligence (2 Hrs.)**

Intelligent System, Computational Intelligence, Computational Intelligence Paradigms (ANN, Evolutionary Computation, Swarm Intelligence, Artificial Immune Systems, Fuzzy Systems)

### **Unit 2: Neural Network (5Hrs.)**

Single Layer Neural Network: Introduction to neural network, Rosenblatt's neuron, Perceptron training algorithm, Perceptron convergence algorithm, Activation functions; Multi-Layer Neural Network and Backpropagation: Universal approximation theory, Backpropagation training algorithm, Batch learning and online learning, Cross – validation and generalization; Radial Basis Function Networks: Definition and examples, Radial basis function, The interpolation problem, Training algorithm, Radial basis function network variations, Kernel regression

### **Unit 3: Fuzzy Logic (10 Hrs.)**

Basic Fuzzy Set Theory: Introduction, Natural language and formal models, Fuzzy sets, Interpretation of Fuzzy sets, Representation of Fuzzy sets, Fuzzy logic, Operations on Fuzzy sets, Alpha cuts, The decomposition theory, The extension principle, Compensatory operators; Fuzzy Relations: Introduction, Fuzzy relation and propositions, Crisp relations, Fuzzy logic inference, Fuzzy logic for real valued inputs; Fuzzy Data Analysis: Fuzzy methods in data analysis, Fuzzy clustering (Fuzzy c-Means), Fuzzy classifiers (Fuzzy k-Nearest neighbors); Fuzzy Measures and Fuzzy Integrals: Fuzzy measures, Fuzzy integrals, Training the fuzzy integrals

### **Unit 4: Evolutionary Computation (8 Hrs.)**

Introduction to Evolutionary Computation: Generic evolutionary algorithms, Biological evolution, Simulated evolution, Representation – The chromosome, Initial population, Fitness function, Selection (Selective pressure, Random selection, Proportional selection, Tournament selection, Rank based selection, Boltzmann selection, Elitism, Hall of fame), Reproduction operators, Stopping conditions; Evolutionary Optimization: Global numerical optimization, Combinatorial optimization, Constraint handling approaches, Multi objective optimization, Dynamic and noisy environments, Niching, Strategy parameters and Self-adaptation; Elements of Evolutionary

Algorithms: Encoding of solution candidates (Hamming cliffs, Epistasis, Closeness of the search space), Genetic operators

### **Unit 5: Computational Swarm Intelligence (9 Hrs.)**

5.1 Particle Swarm Optimization: Basic principles of computational swarm intelligence, Particle swarm optimization (Influence of the parameters, Turbulence factor, Boundary handling, Global best and local best PSO), Social network structures, Basic variations (Velocity clamping, Inertia weight, Construction coefficient, Synchronous vs. Asynchronous updates, Velocity models)

5.2 Single Solution Particle Swarm Optimization: Guaranteed convergence PSO, Social based PSO, Hybrid algorithm, Sub swarm based PSO, Multi start PSO algorithm, Repelling models, Binary PSO, Multi-objective PSO

### **Unit 6: Deep Learning (11Hrs.)**

Basic Idea: Introduction to Deep Learning, Common architectural principles of Deep Networks (Parameters, Layers, Activation functions, Loss functions, Optimization algorithm, Hyper parameters); Major Architectures of Deep Networks: Generative Adversarial Networks, Convolutional Neural Network (CNN Architecture, Input layers, Convolution layers, Pooling layers, Fully connected layers), Recurrent Neural Network (RNN architecture, Modeling the time dimension, LSTM networks); Transformers: Encoder decoder architecture, Issues with RNN encoder decoder, Attention mechanism

### **Laboratory Works:**

Students should implement different concepts of computational intelligence models studied in each unit of the course during lab time and should submit a small model at the end of the course.

### **References:**

1. Andries P. Engelbrecht, Computational Intelligence, An Introduction, Second Edition, WILEY, 2007
2. James M. Keller, Derong Liu, David B. Fogel, Fundamentals of Computational Intelligence, WILEY, 2016
3. Rudolf Kruse, Christian Borgelt, Christian Braune, Sanaz Mostaghim, Matthias Steinbrecher, Computational Intelligence, A Methodological Introduction, Second Edition, Springer, 2016
4. Deep Learning: A Practitioner's Approach, O'Reilly, Josh Patterson and Adam Gibson, 2017

## Internet of Things

**Course Title:** Internet of Thing  
**Course No:** MIT 556  
**Nature of the Course:** Theory + Lab  
**Semester:** II

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

### Course Description:

This course covers the state of the art in communication, networking and data collection technologies for the IoT. This course focuses on the design of IoT-based solutions for multi-discipline challenges. The course consists of lectures on the fundamental building blocks and protocols in IoT.

### Course Objectives:

The main objective of this course is to provide the students with the advanced competitive skills required to contribute to the development of the IoT.

### Course Contents:

#### Unit 1: Introduction to Internet of Things (8 Hrs.)

Introduction, Definition and characteristics of IoT, Physical design of IoT (Things in IoT, IoT Protocols), Logical design of IoT (IoT functional blocks, IoT communication models, IoT communication APIs), IoT enabling technologies, IoT levels and deployment templates

#### Unit 2: IoT Design Methodology (8 Hrs.)

Purpose and requirement specification, Process specification, Domain model specification, Information model specification, Service specification, IoT level specification, Functional view specification, Operational view specification, Device and system integration, Application development,

#### Unit 3: IoT Sensing and Actuation (9 Hrs.)

Sensors, Characteristics of sensor, Sensors deviations, Sensing types (Scalar, multimedia, hybrid, virtual), Actuators, Actuator types (Hydraulic, Pneumatic, Electric, Thermal, Mechanical, Soft), Actuator characteristics

#### Unit 4: IoT Processing Topologies and Types (7 Hrs.)

Data format, Processing topologies, IoT Device design and selection considerations, processing offloading (Offload location, Offload decision making, Offloading considerations), IoT connectivity technologies

#### Unit 5: IoT Communication Technologies (6 Hrs.)

Introduction, Infrastructure protocols, Discovery protocols, Data protocols, Identification protocol, Device management, Semantics protocols

#### Unit 6: IoT Analytics (7 Hrs.)

Introduction, KNN, Decision tree, Random forest, K-Means, Agglomerative clustering, DBSCAN, Performance metrics

**References:**

1. Internet of Things: A Hands-On Approach, Arshadeep Bahga, Vijay Madisetti, 2014
2. Introduction to IoT, Cambridge University Press, Sudip Mishra, Anandarup Mukherjee, Arijit Roy, 2021

## Data Structure and Algorithms Analysis

**Course Title:** Data Structure and Algorithms Analysis

**Course No:** MIT557

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

**Semester:** II

**Full Marks:** 45+30

**Pass Marks:** 22.5+15

**Credit Hrs:** 3

### Course Description:

This course includes the basic foundations in of data structures and algorithms with its analysis. This course covers the review of various data structures like stack, queue, list, tree, graphs. Moreover, it focuses on analysis of the algorithm as well as different optimization paradigms and parallel algorithm.

### Course Objectives:

The purpose of this course is to give basic concept of data structure and present the depth in optimization paradigms. Some advance algorithm design techniques and moderate level understanding in computational complexity theory.

### Course Contents:

#### Unit 1: Data Structure (4 Hrs.)

Elementary Data Structure: Abstract data type, Basic operation on stack, queue and linked list; Height Balanced Tree: AVL trees, Red – Black trees

#### Unit 2: Foundation of Algorithm Analysis (5 Hrs.)

Algorithm and its properties: RAM model, Time and Space Complexity, detailed analysis of algorithms (Like factorial algorithm), Concept of Aggregate Analysis; Asymptotic Notations: Big-O, Big- $\Omega$  and Big- $\Theta$  Notations their Geometrical Interpretation and Examples; Recurrences: Recursive Algorithms and Recurrence Relations, Solving Recurrences (Recursion Tree Method, Substitution Method, Application of Masters Theorem)

#### Unit 3: Iterative Algorithms (3 Hrs.)

Searching Algorithms: Sequential Search and its analysis; Sorting Algorithms: Bubble, Selection, and Insertion Sort and their Analysis

#### Unit 4: Divide and Conquer Algorithms (6 Hrs.)

Searching Algorithms: Binary Search, Min-Max Finding and their Analysis; Sorting Algorithms: Merge Sort and Analysis, Quick Sort and Analysis (Best Case, Worst Case and Average Case), Heap Sort (Heapify, Build Heap and Heap Sort Algorithms and their Analysis), Randomized Quick sort and its Analysis; Multiplication of Large integers

#### Unit 5: Greedy Paradigm (7 Hrs.)

Optimization Problems and Optimal Solution, Introduction of Greedy Algorithms, Elements of Greedy Strategy, Fractional Knapsack, Job sequencing with Deadlines, Kruskal's Algorithm, Prims Algorithm, Dijkstra's Algorithm and their Analysis, Huffman Coding: Purpose of Huffman Coding, Prefix Codes, Huffman Coding Algorithm and its Analysis

**Unit 6: Dynamic Paradigm (7 Hrs.)**

Greedy Algorithms vs Dynamic Programming, DP Algorithms: Computing binomial coefficient, Matrix Chain Multiplication, String Editing, Zero-One Knapsack Problem, Optimal binary search tree, Floyd Warshshall Algorithm, Travelling Salesman Problem and their Analysis

**Unit 7: Backtracking (2 Hrs.)**

Concept of Backtracking, Recursion vs Backtracking, Backtracking Algorithms: Subset-sum Problem, Zero-one Knapsack Problem, N-queen Problem and their Analysis

**Unit 8: Branch and Bound (2 Hrs.)**

Assignment problem, Knapsack problem, Travelling salesman problem

**Unit 9: Introduction to Parallel Algorithms (8 Hrs.)**

Parallel processing paradigms: Semantics of concurrent programming (Axiomatic, Denotational, Operational); PRAM models: PRAM Algorithms (Computing prefix sum, Parallel sorting algorithm); Parallel graph algorithms: Tree graph algorithm (computing post order numbering, computing the number of descendants, level computation, Lowest Common Ancestor computation)

**Unit 10: NP Completeness (2 Hrs.)**

Complexity classes (P, NP, NP Complete, NP Hard), Problem reducibility, Approximation algorithm: Vertex cover algorithm

**Laboratory Works:**

Students should implement the algorithms and analyze their behavior, with respect to time as well as memory.

**References:**

- 1 Y. Langsam, M. J. Augenstein and A. M Tenenbaum, "Data Structures using C and C++", PHI, 2<sup>nd</sup> Edition
- 2 T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms", PHI, 3<sup>rd</sup> Edition

## **E-Commerce and E-Business**

**Course Title:** E-Commerce and E-Business  
**Course No:** MIT558  
**Nature of the Course:** Theory + Practical  
**Semester:** II

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

### **Course Description:**

The course introduces the fundamentals and infrastructure of e-Commerce and e-Business to familiarize students with related new technology development. The tentative topics include but are not limited to Internet business models, e-commerce infrastructure, e-Payment system, e-SCM, e-CRM, and e-Procurement

### **Course Objectives:**

Students are expected to understand recent developments in e-Business and be able to employ e-Business strategically to enhance business processes. Students will be able apply skills and knowledge in planning, designing and restructuring of business using digital tools

### **Course Contents:**

#### **Unit 1: Introduction to digital business and e-commerce (6 Hrs.)**

Introduction, The impact of electronic communications on traditional businesses, difference between digital business and e-commerce, Digital business opportunities, Risks and barriers to digital business adoption, Barriers to consumer Internet adoption

#### **Unit 2: Marketplace analysis for e-commerce (5 Hrs.)**

Introduction, Business and revenue models for e-commerce, online marketplace analysis, Location of trading in the marketplace, Business models for e-commerce, online start-up companies.

#### **Unit 3: Managing digital business infrastructure (6 Hrs.)**

Introduction, Digital business infrastructure components, introduction to Internet technology, Management issues in creating a new customer-facing digital service, Focus on Web services, SaaS, cloud computing and service-oriented architecture (SOA), Managing internal digital communications through intranets and extranets, Web presentation and data exchange standards, Internet governance

#### **Unit 4: E-environment (4 Hrs.)**

Introduction, Social and legal factors, Environmental and green issues related to Internet usage, E-government, Technological innovation and technology assessment

#### **Unit 5: Digital business strategy (6 Hrs.)**

Introduction, digital business strategy, Strategic analysis, Strategic objectives, Strategy definition, Strategy implementation, Aligning and impacting digital business strategies

**Unit 6: Supply chain management (6 Hrs.)**

Introduction, Supply Chain management, Value chain, Options for restructuring the supply chain, Using digital business to restructure the supply chain, Supply chain management implementation, Goal-setting and performance management for e-SCM

**Unit 7: E-procurement (6 Hrs.)**

Introduction, e-procurement, drivers of e-procurement, Estimating e-procurement costs, Barriers and risks of e-procurement adoption, Implementing e-procurement, B2B marketplaces, future of e-procurement

**Unit 8: Customer relationship management (6 Hrs.)**

Introduction, e-CRM, Conversion marketing, Online buying process, Customer acquisition management, Marketing communications for customer acquisition including search engine marketing, online PR, online partnerships, interactive advertising, email marketing, and social media marketing, Social media and social CRM strategy, Customer retention management, Excelling in e-commerce service quality, Customer extension, Technology solutions for CRM

**Laboratory Works:**

Student should design and construct e-Commerce and e-Business applications and mobile applications using tools of their interest

**References:**

1. Dave Chaffey, Tanya Hemphill, David Edmundson-Bird, Digital Business and E-Commerce Management, Pearson; 7th edition, 2019.
2. Kenneth Laudon and Jane Laudon, E-Commerce 2019: Business, Technology and Society, Pearson Education, 15<sup>th</sup> Edition, 2019.
3. Schneider, Gary, Electronic Commerce, 12<sup>th</sup> Edition, Cengage Learning, 2016.
4. Strauss, Judy and Frost, Raymond D., E-Marketing, 8<sup>th</sup> Edition, Routledge, 2018. Turban, E., Outland, J., King, D., Lee, J. K., Liang, T. P., and Turban, D. C., Electronic Commerce 2018: A Managerial and Social Networks Perspective, 9<sup>th</sup> Edition, Springer, 2018.

## **Advanced Programming**

**Course Title:** Advanced Programming  
**Course No:** MIT559  
**Nature of the Course:** Theory + Practical  
**Semester:** II

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

### **Course Description:**

This course covers data processing, inferential statistics, data visualization, machine learning, text mining, and big data processing using with python.

### **Course Objectives:**

The main objective of this course is to enable student to write python programs related to data science and data visualization.

### **Course Contents:**

#### **Unit 1: Data Processing and Inferential Statistics (12 Hrs.)**

Review of NumPy Arrays, data analysis with Pandas, Data Cleansing, Data Operations, Various forms of distribution, z-score, p-value, One-tailed and two-tailed tests, Type 1 and Type 2 errors, confidence interval, Correlation, Z-test vs T-test, F distribution, chi-square distribution, Chi-square for the goodness of fit, The chi-square test of independence, ANOVA

#### **Unit 2: Data Mining and Data Visualization (10 Hrs.)**

Data mining, Presenting an analysis, Studying the Titanic, Controlling the line properties of a chart, Creating multiple plots, Playing with text, Styling your plots, Box plots, Heatmaps, Scatter plots with histograms, scatter plot matrix, Area plots, Bubble charts, Hexagon bin plots, Trellis plots, 3D plot of a surface

#### **Unit 3: Python for Intelligence (14 Hrs.)**

Different types of machine learning, Decision trees, Linear regression, Logistic regression, naive Bayes classifier, k-means clustering, Hierarchical clustering, Performing Predictions with a Linear Regression, Estimating the Likelihood of Events using Logistic regression, Generating Recommendations with Collaborative Filtering, Making Prediction with Ensemble Methods, Applying Segmentation with k-means Clustering

#### **Unit 4: Python for Text Mining and Big Data (9 Hrs.)**

Preprocessing data, Creating a wordcloud, Word and sentence tokenization, Parts of speech tagging, Stemming and lemmatization, The Stanford Named Entity Recognizer, Performing sentiment analysis on world leaders using Twitter, Hadoop, Python MapReduce, File handling with Hadoopy, Pig, Python with Apache Spark

### **Laboratory Works:**

Students need to write python programs to illustrate inferential statistics, data visualization, machine learning algorithms, text mining, and big data processing

**References:**

1. Samir Madhavan, Mastering Python for Data Science: Explore the world of data science through Python and learn how to make sense of data, Ingram short title, First Edition, 2015
2. Sebastian Raschka Vahid Mirjalili, Python Machine Learning: Machine Learning and Deep Learning with Python, Ingram short title, Second Edition, 2017
3. Alberto Artasanchez and Prateek Joshi, Artificial Intelligence with Python: Your complete guide to building intelligent apps using Python 3.x, Packt Publishing Limited, Second Edition 2020

## Seminar

**Course Title:** Seminar  
**Course No:** MIT555  
**Nature of the Course:** Seminar  
**Semester:** II

**Full Marks:** 25  
**Pass Marks:** 12.5  
**Credit Hrs:** 1

**Course Description:** The seminar is of full marks 25 offered in the curriculum of the MIT first year first semester. A student pursuing the seminar prepares a seminar report and presents the seminar in the department. Once accepted by the department, the students have to submit the final copy of the report.

### **Introduction:**

Each student is required to write a comprehensive report about the seminar. The report should consist of 5 to 10 pages describing the topic selected. Students can choose the seminar topics of their relevant subject area. The students are suggested to select the research oriented topics rather than just informative ones. The report should be in the format as described below;

### **Arrangement of Contents:**

The sequence in which the seminar report material should be arranged and bound should be as follows:

1. Cover Page & Title Page
2. Abstract
3. Chapters:
  - a. Introduction
  - b. Previous Works, Discussions and Findings
  - c. Conclusion
4. References

### **Format of References**

#### **1. References**

A list of all publications (articles, texts, monographs, etc.) must be supplied as the last section of the paper. Each article or paper used must be listed alphabetically by last name of the author and the list must be numbered sequentially. The following are examples of the format for various types of entries in the list.

**Journal:** Stalling, W., RSA and its computational aspects, *Infoworld*, 12, 28 (Jul. 2012), 42-49.

**Book:** Bishop, M. and Boneh, D., *Elements of Computer Security*, Pearson Education., 2009.

**Proceedings:** Shamir, A., Controlling attacks on public key cryptography. *Proceedings of OOPSLA 86* (Sept. 1986., Portland), 405-416.

**Articles Which Have Established Citation Pages at ACM (Electronically published articles):** Smith, J., An algorithm for the traveling salesman problem, *Journal of the ACM* 54 (June 2011), 234-245. (<http://www.acm.org/jacm/2011/SmithtspAlgo/>)

## 2. Citations

Whenever material from a publication is used in the paper it must be followed by a citation which is simply the number of the reference in the list of references enclosed in square brackets (for example, a reference to the third article listed in the list of references would contain the citation [3].) Multiple citation numbers can be incorporated within one citation when required (for example, references to the fourth, eighth, and eleventh entries in the reference list would appear as [4, 8, 11]).

### **Text of the seminar paper format:**

1. The paper can be prepared using a word processor or LATEX. The students are highly recommended to use LATEX.
2. Margins - All margins must be one inch.
3. The text must be spaced by 1.5.
4. The text must be typed in 12 point font. The text must be typed in Times New Roman font.

**MIT**

**Third and Fourth Semester**

**Syllabus**

**2081**

## **Cyber Security and Digital Forensics**

**Course Title:** Cyber Security and Digital Forensics

**Course No:** MIT601

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

**Semester:** III

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs.:** 3

### **Course Description:**

This course introduces the concepts of cyber security and digital forensics. The topics covered include basics of cyber security, digital forensic, forensic process, concepts of digital evidence, forensic analysis, web and e-mail forensics, mobile and cloud forensics.

### **Course Objectives:**

The main objective of this course is to make students familiar with the concepts of cyber security focusing on digital forensics. Upon completion of this course students will be able to understand and use the cybersecurity practices and digital forensic tool for ensuring security and performing forensics in cyberspace.

### **Course Contents:**

#### **Unit 1: Cybersecurity (4 Hrs.)**

Cyberspace, Cybersecurity; NIST Cybersecurity Framework; Cybersecurity Management Process; Cybersecurity Threats and Attacks; Cyber Kill Chain; Vulnerability Assessment; Penetration Testing; Ethical Hacking; Cyber Law: Global and Local

#### **Unit 2: Digital Forensics (10 Hrs.)**

Digital Forensic; Cyber Crime; Digital Forensic Categories; Digital Forensic Users; Digital Forensic Investigation Types; Forensics Readiness; Digital Evidence; Digital Forensics Examination Process

Basic Concepts of Data Representation; Computer Character Encoding Scheme; File Structure; Digital File Metadata; Timestamps; Hash Analysis; Data Storage on HDD; Host Protected Area; Device Configuration Overlay; File Systems: NTFS, FAT

#### **Unit 3: Computer Forensics Lab Requirements (4 Hrs.)**

Physical Facility Requirements; Environment Controls; Hardware Equipment; Furniture and Consumable Materials; Evidence Container; Forensic Workstation; Forensic Software; Validation and Verification of Forensics Hardware and Software; Secrecy Requirement; Lab Data Backup; Training Requirements; Policies and Procedures; Documentation; Lab Accreditation

#### **Unit 4: Forensic Process (5 Hrs.)**

Initial Response; Search and Seizure: Consent to Search, Subpoena, Search Warrant; First Responder Toolkit; First Responder Tasks; Order of Volatility; Documenting the Digital Crime Scene; Packaging and Transporting Electronic Devices; Conducting Interview

#### **Unit 5: Acquiring and Analyzing Digital Evidence (8 Hrs.)**

Acquiring Digital Evidence: Forensic Image File Formats; Forensics Image File Validation; Acquiring Volatile Memory; Acquiring Non-Volatile Memory; Analyzing Hard Drive Forensic Image; Analyzing RAM Forensic Image

#### **Unit 6: Forensics Analysis (6 Hrs.)**

Timeline Analysis; File Recovery; Registry Analysis; File Format Identification; Windows Features Forensics Analysis

#### **Unit 7: Web Browser and E-mail Forensics (4 Hrs.)**

Web Browser Forensics; E-mail Forensics

#### **Unit 8: Mobile and Cloud Forensics (4 Hrs.)**

Mobile Device Forensics; Acquisition Procedure for Mobile Devices; Mobile Forensic Equipment; Mobile Forensics Tools;

Cloud Forensics; Challenges in Cloud Forensics; Challenges Forensics; Acquisitions in Cloud; Cloud Investigation; Tools for Cloud Forensics

#### **Laboratory Works:**

Laboratory works include implementing and simulating tools and techniques for ensuring cyber security and performing digital forensics. The laboratory should also include case studies of cyber-attacks and digital forensics.

#### **Reference Books:**

1. Nihad A. Hassan, Digital Forensics Basics: A Practical Guide Using Windows OS, Apress, 2019
2. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide To Computer Forensics and Investigations, Cengage Learning, 6th edition, 2018
3. William Stallings, Effective Cyber Security, Addison-Wesley, 2019
4. Joanna F. DeFranco, Bob Maley, What Every Engineer Should Know About Cyber Security and Digital Forensics, CRC Press, 2<sup>nd</sup> Edition, 2023
5. Joakim Kävrestad, Fundamentals of Digital Forensics: Theory, Methods, and Real-Life Applications, Springer, 2nd Edition, 2020

## **Data Analytics and Visualization**

**Course Title:** Data Analytics and Visualization

**Course No:** MIT602

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

**Semester:** III

**Full Marks:** 45+30

**Pass Marks:** 22.5+15

**Credit Hrs.:** 3

### **Course Description:**

This course covers time series forecasting, machine learning and deep learning models for regression and classification, and text analytics with python.

### **Course Objectives:**

The main objective of this course is to enable student to write python programs related to data analytics and visualization.

### **Course Contents:**

#### **Unit 1: Data Visualization (6 Hrs.)**

Direct Plotting, Plotting with Matplotlib, Plotting with Seaborn, Line Plot, Bar Plot, Pie Chart, Box Plot, Histogram Plot, Scatter Plot, Strip Plot, Swarm Plot, Joint Plot, Stack Plot, Heatmaps, Multiple Plots, Adding Text.

#### **Unit 2: Time Series Forecasting (9 Hrs.)**

Concept and Components of Time Series, Autocorrelation and Partial Autocorrelation Function, Correlogram, Autoregression, Moving Average, Autoregressive Moving Average, Autoregressive Integrated Moving Average, Seasonal Autoregressive Integrated Moving Average, Seasonal Autoregressive Integrated Moving-Average with Exogenous Regressors, Vector Autoregression, Vector Autoregression Moving Average, Vector Autoregression Moving-Average with Exogenous Regressors, Simple Exponential Smoothing, Holt Winter's Exponential Smoothing, Visualizing Result of Each Technique.

#### **Unit 3: Data Analytics with Machine Learning (12 Hrs.)**

Scales of Measurement, Feature Engineering, Exploratory Data Analysis (EDA), Performance Metrics for Regression and Classification Algorithms, Regression and classification using KNN, ID3 vs. C4.5 vs. CART Decision Trees, Random Forest, classification and regression using support vector machine, Gradient Boosting using XGBoost and LightGBM, Dimensionality reduction using PCA and ICA, Visualizing Result of Each Algorithm.

#### **Unit 4: Data Analytics with Deep Learning (9 Hrs.)**

Regression and Classification using Multiplayer Perceptron, Gradient Descent Optimizers, Recurrent Networks, Long Short-term Memory, Gated Recurrent Unit Networks, Auto-Encoder, Generative Adversarial Networks, Visualizing Result of Each Model.

**Unit 5: Text Analytics (9 Hrs.)**

Review of Text Preprocessing, One Hot Encoding, Count Vectorization, TF-IDF Vectorization, Word Embeddings, Generating N-Grams, Hash Vectorization, Finding Text Similarity, POS Tagging, Entity Extraction, Topic Extraction, Text Classification, Sentiment Analysis, Transformer in NLP, Visualizing Result of Each Algorithm.

**Laboratory Works:**

Students need to write python programs to demonstrate time series forecasting, machine learning and deep learning algorithms for solving classification and regression problems, text preprocessing, text classification and sentiment analysis.

**References:**

1. Dr. Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, First Edition, 2018
2. Sayan Mukhopadhyay, Advanced Data Analytics Using Python: With Machine Learning, Deep Learning and NLP Examples, Apress, First Edition, 2018.
3. Jesus Rogel-Salazar, Data Science and Analytics with Python, Chapman and Hall/CRC, First Edition, 2017.
4. Terence C. Mills, Applied Time Series Analysis: A Practical Guide to Modeling and Forecasting, First Edition, 2019.
5. Manohar Swamynathan, Mastering Machine Learning with Python in Six Steps: A Practical Implementation Guide to Predictive Data Analytics Using Python, Apress, First Edition, 2017.
6. Taweh Beysolow II, Applied Natural Language Processing with Python: Implementing Machine Learning and Deep Learning Algorithms for Natural Language Processing, Apress, First Edition, 2018.
7. Akshay Kulkarni and Adarsha Shivananda, Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, First Edition, 2019.
8. Dipanjan Sarkar, Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data, Apress, First Edition, 2016.

## Digital Governance

**Course Title:** Digital Governance

**Course No:** MIT603

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

**Semester:** III

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs.:** 3

### **Course Description:**

This course addresses the inefficiencies and risks associated with digital technology, emphasizing strategic investment and utilization. It covers fundamental principles like leadership, accountability, and transparency, providing insights to develop and implement digital strategies.

### **Course Objectives:**

The main objective of this course is to make students familiar with different concepts of digital governance, understanding the principles and best practices of digital governance its security

### **Course Contents:**

#### **Unit 1: Introduction and Digital Governance Strategy (5 Hrs.)**

A Digital Governance Manifesto, The Scope of Digital Governance, The Role of the Governing Body; Digital Governance Strategy: A Strategy for Digital Technology, A Pragmatic Approach to Digital Governance, Achieving Good Governance, Strategic Governance Principles, Delivering Strategic Change

#### **Unit 2: Managing rapid change in a digital world (3 Hrs.)**

The Digital Opportunity, The Pace of Change, Getting Started, Getting Digitisation Right, Projects or Programmes?

#### **Unit 3: Digitising Internal Operations (4 Hrs.)**

Introduction, Understanding digitization, Making the case for process digitization, Issues with digitization; Transforming

#### **Unit 4: Transforming Products and Services (4 Hrs.)**

Models of digital transformation, Digitally enhanced products, Digitised products, New business models

#### **Unit 5: Digital Marketing and Sales (6 Hrs.)**

Introduction, Understanding Consumers, Talking to Consumers, Governance of Marketing Assets, Making the Sale, Finding the Right People

#### **Unit 6: Thinking Digital in Mergers, Acquisitions and Venturing (3 Hrs.)**

Introduction, Acquiring services rather than organisations, Assessing the fit, Making it happen

**Unit 7: Assuring Digital Compliance (5 Hrs.)**

Introduction, Why Care About Compliance?, Sources of Compliance Obligations, Becoming Compliant, The Role of Standards, Emerging Compliance Obligations, Rationalisation of Compliance

**Unit 8: Information and Cyber Security (5 Hrs.)**

Introduction, What is All This Fuss About?, Cyber Risk Management, Layered Protection: People, Process and Technology, Protection Through People, Protection through Process, Protection through Technology, Role of the Board in Security

**Unit 9: Delivering Digital Privacy and Digital Resilience (6 Hrs.)**

Introduction, Privacy: An Urgent Priority, Privacy Compliance, Getting it Right, Employers' Vicarious Liability, Embedding Privacy and Minimising Risk; A Grandiose Name for Business Continuity?, Resilience Challenges

**Unit 10: Emerging Digital Technologies (4 Hrs.)**

Introduction, Big Data, Robotic Process Automation and Autonomous Systems, Artificial Intelligence, Internet of Things, Wearables, 3D Printing, Distributed Ledgers And Blockchain, Virtual Reality and Augmented Reality, Implants and Brain-Computer Interfaces

**Laboratory Works:**

Students should implement and realize digital governance using appropriate tools and techniques.

**References:**

1. Jeremy Swinfen Green and Stephen Daniels, Digital Governance: Leading and Thriving in a World of Fast-Changing Technologies, 2<sup>nd</sup> Edition, 2019
2. Michael E. Milakovich, Digital Governance: Applying Advanced Technologies to Improve Public Service, 2019
3. Data Governance for Managers: The Driver of Value Stream Optimization and a Pacemaker for Digital Transformation, Lars Michael Bollweg, Springer, 2022

## Term Paper

**Course Title:** Term Paper  
**Course No:** MIT604  
**Nature of the Course:** Seminar  
**Semester:** III

**Full Marks:** 50  
**Pass Marks:** 25  
**Credit Hrs.:** 2

### Course Description:

The course covers concepts of exploring research writing in a specific area of information technology. The term paper is designed to allow students to investigate deeper into a specific topic related to the field of study. The course includes conducting independent research with proper analysis and presenting the findings and results in a structured format.

### Course Objectives:

The objective of this course is to make students familiar with:

- Developing critical thinking and analytical skills.
- Developing academic writing skills.
- Demonstrating understanding of specific context/topic.
- Implementing and simulating problem solutions.
- Conducting independent research.
- Using scholarly resources.

### Course Contents:

Each student is required to write a comprehensive report about the term paper activity. Students can choose the term paper topics of their relevant subject area. The students are suggested to select the research oriented topics rather than just informative and fundamental theories only. The report should be in the following format.

### Term Paper Content:

1. Cover & Title Page
2. Supervisor Recommendation
3. Head/Coordinator, Supervisor, and Internal Examiners' Approval Letter
4. Acknowledgement
5. Abstract
6. Table of Contents
7. List of Abbreviations/List of Figures/List of Tables
8. Main Report
9. References
10. Appendices

The main report should be in following content hierarchy:

1. Chapter 1: Introduction
  - a. Introduction
  - b. Problem Statement
  - c. Objectives
  - d. Report Organization
2. Chapter 2: Background Study and Literature Review
  - a. Background Study
  - b. Literature Review
3. Chapter 3: Methodology
  - a. Methodology
  - b. Algorithm/Mathematical Models/Implementation Details
4. Chapter 4: Result Analysis
  - a. Findings and Observations
  - b. Result Analysis
5. Chapter 5: Conclusion and Future Work
  - a. Conclusion
  - b. Future Work

**Formatting Guidelines:**

1. The report can be prepared using a word processor or LATEX. The students are highly recommended to use LATEX.
2. Margins - All margins must be one inch.
3. The text must be spaced by 1.5.
4. The text must be typed in 12 point font.
5. The text must be typed in Times New Roman font.
6. The tables should be captioned above it. The table number should be labeled as per the chapter number i.e. the first table in chapter 1 should be captioned Table 1.1 and so on.
7. The figures should be captioned below it. The figure number should be labeled as per the chapter number i.e. the first figure in chapter 1 should be captioned Figure 1.1 and so on.

**Referencing and Citation Format: APA**

**Provision of Supervision:**

Supervisor should be the regular faculty member of MIT program at the department/campus. The role of supervisor is to supervise the students in the term paper.

## Evaluation Scheme

Students should submit and present the term paper. The term paper work will be evaluated by an evaluation committee. The term paper evaluation committee comprises three members, namely, Head of the Department/Program Coordinator, Internal Examiner and Supervisor. The internal examiner should be the regular faculty of MIT program at the department/campus. Each of the members will evaluate the student's work individually based on the following scheme and the average of the evaluation will be the final evaluation.

S.N.	Topic	Full Marks
1	Overall Work	10
2	Overall Presentation	10
3	Overall Report	8
4	List of Tables, Charts, Groups, Figures/ Captions	6
5	Abstract and Conclusion	6
6	References	4
7	Question/Answer	6
	Total	50

- Supervisor : 60% of 50=30
- Internal Examiner: 30% of 50=15
- HOD / Co-Coordinator / Director: 10% of 50=5

## Final Report Submission

A final approved signed copy of the term paper should be submitted to the department/campus after successful defense of the work.

## **Digital Economy**

**Course Title:** Digital Economy  
**Course No:** MIT605  
**Nature of the Course:** Theory + Lab  
**Semester:** III

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

### **Course Description:**

This course provides a comprehensive understanding of the digital economy, focusing on digital assets such as crypto currencies, blockchain technology, digital tokens, and decentralized finance (DeFi). Through a blend of theoretical foundations and practical applications, students will explore the evolution of digital money, the mechanics of digital market platforms, the intricacies of block chain technology, and the revolutionary potential of DeFi.

### **Course Objectives:**

This course focuses on making students understand the history and evolution of physical and digital money, analyze the functioning and economic impact of digital market platforms. It also emphasizes on providing in-depth knowledge of crypto currencies, their ecosystems, and smart contracts, various types of digital tokens and their transactions. It also comprehends the purpose, types, and applications of blockchain technology. It also explores decentralized finance's concepts, origin, and components (DeFi) and the future of block chain and Web 3.0

### **Course Contents:**

#### **Unit 1: Introduction to Digital Economy (7 Hrs.)**

Physical and digital money: history, different forms, currency pegs, banks and e-money wallets, Digital market platforms as economic practice: search engines, social media, e-commerce platforms, online games

#### **Unit 2: Blockchain Technology (15 Hrs.)**

Introduction of blockchain, Distributed, Centralized, and decentralized computing, Permissioned vs. permission less blockchain, Blockchain application: Insurance, Health Management, Defense, Healthcare, Food, Credit Rating, Data management, Internet Security, Logistics and Supply chain, Proliferation of blockchain technology, Initial coin offering, Consensus mechanism: PoW, PoS, Hybrid, dBFN, and Proof of Concept

#### **Unit 3: Digital Assets (10 Hrs.)**

Bitcoin and its issues: Working mechanism, mining, wallets, bitcoin address, blocksize, split, transaction fees, bitcoin supply and its future, Ethereum ecosystem and smart contracts, Digital Tokens: Introduction, types of tokens (native, asset-backed, contract, and utility), and transactions

**Unit 4: Decentralized Finance (DeFi) (10 Hrs.)**

Introduction, History, Key Issues in DeFi and Advantages over traditional approach, DeFi primitives: Transactions, Fungible and non-fungible tokens, Custody, Supply adjustment, Swap, Collateralized and uncollateralized loans, Blockchain as DeFi infrastructure, DeFi applications: Credit/Lending, Decentralized access, Derivatives, Tokenization

**Unit 5: Future of Blockchain and Web 3.0 (3 Hrs.)**

Introduction, Combinatorial innovations, metaverses, and beyond, Web 3.0 aspirations for decentralization and inclusivity

**References:**

1. Lewis, A., *The Basics of Bitcoins and Blockchains*. Mango, 2018
2. Mei, L., *Blockchain, Bitcoin, and the Digital Economy*. Mercury Learning and Information, 2022
3. Jordan, T., *The Digital Economy*, Polity, 2020
4. Harvey, C. R., Ramachandran, A., & Santoro, J., *DeFi and the Future of Finance*. John Wiley & Sons, 2021
5. Lacity, M. C., & Lupien, S. C., *Blockchain Fundamentals for Web 3.0*. University of Arkansas Press, 2022

## Mobile Computing

**Course Title:** Mobile Computing

**Course No:** MIT606

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

**Semester:** III

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs.:** 3

### **Course Description:**

This course will provide a comprehensive understanding of the principles and techniques necessary for developing adaptive mobile applications and managing mobility in cellular networks and MANETs.

### **Course Objectives:**

The primary objectives of this course are to equip students with a thorough understanding and practical skills in the field of mobile computing.

### **Course Contents:**

#### **Unit 1: Mobile Adaptive Computing (3 Hrs.)**

What Is Mobile Computing?, Adaptability—The Key to Mobile Computing, Mechanisms for Adaptation, How to Develop or Incorporate Adaptations in Applications?, Support for Building Adaptive Mobile Applications

#### **Unit 2: Mobility Management (5 Hrs.)**

Mobility Management, Location Management Principles and Techniques, Location Management Case Studies

#### **Unit 3: Handoff in Wireless Mobile Networks (5 Hrs.)**

Introduction, Types of Handoffs, Handoff Initiation, Handoff Decision, Handoff Schemes

#### **Unit 4: Location Management in Cellular Networks (6 Hrs.)**

Introduction, Cellular Networks, Location Management, Common Assumptions for Performance Evaluation, Location Management Schemes

#### **Unit 5: Heuristics for Solving Fixed-Channel Assignment Problems (7 Hrs.)**

Introduction, Resource Management Tasks, Interference in Cellular Systems, Frequency Management and Channel Assignment Issues, Channel Assignment, Fixed-Channel Assignment Problem, Heuristic Techniques for Combinatorial Optimization, Heuristic FCA Schemes

#### **Unit 6: Data Dissemination and Management (3 Hrs.)**

Challenges, Data Dissemination, Mobile Data Caching, Mobile Cache Maintenance Schemes, Mobile Web Caching

**Unit 7: Context-Aware Computing (3 Hrs.)**

Ubiquitous or Pervasive Computing, What Is a Context? Various Definitions and Types of Contexts, Context-Aware Computing and Applications, Middleware Support

**Unit 8: Introduction to Mobile Middleware (3 Hrs.)**

What is Mobile Middleware?, Adaptation, Agents, Service Discovery

**Unit 9: Introduction and algorithm for MANET (5 Hrs.)**

Introduction, Layered Architecture of Mobile Ad Hoc Networks, MAC Layer, Mobile Ad Hoc Networks and the Internet, Routing in Self-Organized Networks, People-Based Networks; Introduction, Design Challenges, MANETs: An Algorithmic Perspective, Applications

**Unit 10: Introduction to Ubiquitous and Mobile Edge Computing (5 Hrs.)**

Introduction, Fundamental concepts of Mobile and Ubiquitous Computing, Basic concepts of Mobile Edge Computing

**Laboratory Work:**

Students should implement and realize different mobile computing and MANET concepts.

**References:**

1. Frank Adelstein, S. K. S. Gupta, Golden G. Richard III, and Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, 2005
2. Ivan Stojmenovic, Handbook of Wireless Networks and Mobile Computing, 2002
3. Azzedine Boukerche, Algorithm and Protocols for Wireless and Mobile Ad Hoc Networks, 2009
4. Yan Zhang, Mobile Edge Computing, 2022
5. John Krumm, Ubiquitous Computing Fundamentals, 2010

## **Human Computer Interaction**

**Course Title:** Human Computer Interaction

**Course No:** MIT 607

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

**Semester:** III

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs.:** 3

### **Course Description:**

This course covers different fundamental theories and concepts of human computer interaction. HCI is an interdisciplinary field that integrates theories and methodologies across many domains including cognitive psychology, neurocognitive engineering, computer science, human factors, and engineering design.

### **Course Objectives:**

The main objective of this course is to provide fundamental knowledge on the basic physiological, perceptual, and cognitive components of human learning and memory and to develop an awareness of the range of general human-computer interaction issues that must be considered when designing information systems.

### **Unit 1: Foundations (7 Hrs.)**

Introduction: Cognitive Psychology and Computer Science, Capabilities of HCI, Goals and Roles of HCI, Architecture of HCI System, Ubiquitous Computing and Ambient intelligence

The Human: Input - Output Channels, Human Memory, Thinking: Reasoning and Problem Solving, Emotion, Individual Differences, Psychology and the design of Interactive systems

The Computer: Text Entry Devices, Positioning, Pointing and Drawing, Display Devices, Devices for Virtual Reality, Physical Control, Printing and Scanning, Memory, Processing and Networks

The Interaction: Models of Interaction, Frameworks and HCI, Ergonomics, Interaction Styles, Interactivity, The Context of the Interaction, Experience, Engagement and Fun

### **Unit 2: Design Process (15 Hrs.)**

Interaction Design Basics: Design, Process of design, User focus, Scenarios, Navigation Design, Screen design and Layout, Iteration and Prototyping

HCI in Software Process: Software Life Cycle, Usability Engineering, Design Rationale

Design Rules: HCI and usability engineering, Principles to support usability, Standards, Guidelines, Golden Rules and Heuristics, HCI Patterns

Evaluation Techniques: Goals of Evaluation, Evaluation through expert analysis and user participation, choosing an Evaluation method

Universal Design: Universal Design Principles, Multi Modal Interaction, Designing for Diversity

User Support: Requirement of user support, Approaches to user support, Adaptive Help systems, designing user support systems

### **Unit 3: Models and Theories (20 Hrs.)**

Cognitive Models: Goal and Task hierarchies, Linguistic models, Challenges of display based system, Physical and device models, Cognitive architectures

Communication and Collaborative models: Face to face communication, Conversation, Text based communication, Group working

Dialog notations and design: Dialog design notation, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design

Spoken Dialogue System: General architecture of spoken dialogue system, Voice activity detection, Automatic speech recognition, Natural language understanding, Natural language generation, Text to speech synthesis

Computational Models for Dialogue Management: Finite state based approach, Frame based approach, Agent based approach

Statistical Approaches to Dialogue Management: Reinforcement learning, Dialogue as Markov decision process

Models of the systems: Standard formalisms, Interaction models, Continuous behaviors

Modeling rich interaction: Status event analysis, Rich contexts, Low intention and sensor based interaction

Ubiquitous computing and Augmented Reality: Virtual and Augmented reality, Information and data visualizations

### **Unit 4: Ambient Intelligence (3 Hrs.)**

AmI vision, AmI Contributing Technologies, Context aware systems and HCI, Middleware, Attentive computing. Immersive Interaction

### **Laboratory Works:**

Students should implement different concepts of HCI models studied in each unit of the course during lab time and should submit a small model at the end of the course.

### **References:**

1. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, Human – Computer Interaction, Third Edition, , Pearson , 2004
2. Andrew Sears, Julie A. Jacko, Human-computer interaction. Fundamentals, Human Factors and Ergonomics, CRC, 2009

## **Database Administration**

**Course Title:** Database Administration

**Full Marks:** 45 + 30

**Course No:** MIT608

**Pass Marks:** 22.5 + 15

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

**Credit Hrs:** 3

**Semester:** III

### **Course Description:**

This course provides a comprehensive introduction to Database Administration (DBA) principles and practices using Oracle Database. Students will gain a foundational understanding of Oracle architecture, user and security management, database object manipulation, backup and recovery strategies, performance tuning techniques, and basic automation with the scheduler. The course integrates theoretical knowledge with hands-on labs, equipping students with practical skills for managing and maintaining organizational databases.

### **Course Objectives:**

The main objective of this course is to make students understand the role and responsibilities of a Database Administrator. It also describes the core components of Oracle Database architecture and install and configure an Oracle database instance. It emphasizes on utilizing essential administrative tools like SQL\*Plus, SQL Developer, and Enterprise Manager. It implements user accounts, privileges, and roles for secure access control. It focuses on creating and managing various database objects including tables, indexes, views, and PL/SQL Procedure and Functions. Similarly, it focuses on developing backup and recovery strategies for data protection and disaster preparedness, identifying and applying performance tuning techniques to optimize database operations and automating routine database tasks using the scheduler.

### **Course Contents:**

#### **Unit 1: Introduction (6 Hrs.)**

Tasks of a Database Administrator; Oracle Database Architecture; Oracle Multitenant Architecture, CDB and PDBs; Oracle database instance; Installing and connecting database; Administrative Tools: SQL \*Plus, SQL Developer, Enterprise Manager (EM); SQL Loader; creating a database, Creating Pluggable Databases (PDBs) within a CDB.

#### **Unit 2: Oracle instance Configuration and Storage Management (6 Hrs.)**

Oracle instance configuration using parameter file, control file and its multiplexing, online redo log management and multiplexing, database archiving, managing archive logs; Tablespaces and datafile management, creating and adding tablespace and datafiles, starting and shutdown modes; Undo Management; Oracle Network Configuration and Management.

### **Unit 3: Security and User Management (7 Hrs.)**

Database Security and Auditing; Security Guidelines, Database Authentication and Authorization Methods; Administrative user accounts; Managing user accounts in CDB and PDB; Common and local user accounts; User Authentication; Privilege Management; Granting and revoking system and object level privileges; Role management; Profile management; Monitoring user information.

### **Unit 4: Managing Database Objects (10 Hrs.)**

Tables and constraints, Table Partitioning, Index, view, Materialized view, sequence, synonyms, Introduction of PLSQL, Cursors, Stored Procedure, Functions, Trigger, Records, collections, Exception Handling, Package.

### **Unit 5: Backup, Recovery and High Availability (8 Hrs.)**

Oracle Backup Solutions; Backup and recovery strategies; Database backup, restoration and recovery; Logical and Physical backup; Export and import using DataPump; RMAN backups and recovery; Types of Failure, Instance and media Recovery; Backup and Recovery in multitenant Environment; High Availability Features; Oracle Data Guard; Flashback operations.

### **Unit 6: Database Tuning (5 Hrs.)**

Performance Tuning Methodology, Tuning Activities: Performance Planning, Tuning Application Design, Instance Tuning, Tuning Data Access, Tuning Data Manipulation, Reducing Network Traffic; Automatic Workload Repository (AWR); Automatic Database Diagnostic Monitor(ADDM), Tuning SQL; Execution Plans, SQL Tuning Advisor, Performance Tuning in a Multitenant Environment;

### **Unit 7: Task automation with the Scheduler (3 Hrs.)**

Introduction to the Scheduler, Access Rights, Scheduler Components and Workflow, create a Job, Time Based and Event-Based Schedules

**Laboratory Works:** Laboratory works include implementing the concepts in above mentioned Units in oracle database.

### **References:**

1. Mark Doran, Padmaja Potineni, Rajesh Bhatiy , Oracle Database Administrator's Guide, 21c, Copyright © 1996, 2022
2. Benjamin Rosenzweig, E. R., Oracle PL/SQL by Example. New Yourk: Prentice Hall, 2015
3. Sam R. Alapati , Expert Oracle Database 11g Administration, Apress
4. Michelle Malcher and Darl Kuhn, Pro Oracle Database 18c Administration: Manage and Safeguard Your Organization's Data, Third Edition
5. Craig S. Mullins, Addison Wesley, Database Administration: The Complete Guide to Practices and Procedures

## **IT Entrepreneurship and Innovation**

**Course Title:** IT Entrepreneurship and Innovation

**Course No:** MIT651

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

**Semester:** IV

**Full Marks:** 45+30

**Pass Marks:** 22.5+15

**Credit Hrs.:** 3

### **Course Description:**

This course introduces the concepts of entrepreneurship and innovation in the field of information technology. The topics covered include entrepreneurship, innovation, technology transfers, intellectual properties, business modelling, marketing opportunities, developing ventures and funding and financing strategies for ventures and concepts of pitching startup ideas.

### **Course Objectives:**

The main objective of this course is to make students familiar with the concepts of entrepreneurship and innovation so that upon completion of the course students will be able to understand and use the best practices for IT startup and innovations with proper entrepreneurship skills.

### **Course Contents:**

#### **Unit 1: Technology Entrepreneurship and Innovation (11 Hrs.)**

Introduction; Technology Entrepreneurship and New Ventures; Policy Conditions in Innovation and Entrepreneurship: The Triple Helix, Entrepreneurial Ecosystem; Policy Outcomes and Impacts; Trends influencing Technology Entrepreneurship: Gig Economy, IoT, Convergent Technology Spaces, Crowdfunding

Entrepreneur vs. Technology Entrepreneurs; Characteristics, Motivations and Intentions of Technology Entrepreneurs

Technology Transfer, Technology Transfer Models: Linear Vs. Non-Linear; Technology Transfer Mechanisms: University-Industry, Third-Level Institutions, Start-Ups and Spin-Offs; Stimulants and Barriers to Technology Transfer; Stimulus Factors: Macro vs. Micro Level Factors; Inhibitors to Technology Transfer: Political, Institutional and Project

#### **Unit 2: Creating, Protecting, and Managing Technology and Innovation (11 Hrs.)**

Innovation; Innovation Process; Classification of Innovation: Product and Process, Infrastructure and Platforms, Incremental and Radical, Disruptive, Open; Sources of Innovation; Technology Innovation Life Cycle; Diffusion of Innovations; Managing Innovation

Intellectual Property; Intellectual Property Rights: Patents, Designs, Trademarks, Copyright, Trade-Secrets; Protecting Intellectual Property; Developing Intellectual Property Strategy; Searching Intellectual Property Information; Commercialization of Intellectual Property

Business Modelling: Vision, Value Creation; Business Modelling for Competitive Advantage; Growth Measuring

### **Unit 3: Market Opportunity and Strategy (9 Hrs.)**

Marketing; Marketing Exchanges; Marketing and Technology Entrepreneurship

Marketing Validation Process; Marketing Ecosystem of New Venture; 5C Framework Analysis; Market Validation Outcome; Business Concept Testing Tools; Conducting Market Research; Marketing Strategy

Business Plan and Pitching; Writing Business Plan; Pitching; Criteria for Investors

### **Unit 4: Developing the New Venture (10 Hrs.)**

Venture; Venture Types; Idea Generation Process; Opportunity Register; Idea Sources

Launching Venture: Creating Business Plan, Market Entry Positioning, Market Penetration Strategy, First Mover Advantage, Value Chain Analysis, Contingency Plan

Managing Venture: Managing Venture Strategy, Managing Venture Operations

Funding and Financing New Ventures: Financial Context for New Ventures; Funding and Financing: Early-Stage and Later-Stage; Managing Cash Flow; Investment Decisions; Entrepreneurial Finance; Crowdfunding

Valuing and Exiting Venture: Valuation Techniques, Exit Strategies

### **Unit 5: Pitching Startup Ideas (4 Hrs.)**

Pitching; Importance of Pitching; Components of a Pitch; Maximizing Pitch; Creating Pitch Scenario; Basic Pitch Structure; Pitching on Websites, Emails, Videos; Story Telling in a Pitch

### **Laboratory Works:**

Laboratory works include implementing and simulating digital service models with innovative ideas and working with curated startups on problems of strategic importance. In addition students are expected to perform case studies of IT venture startups and innovations and conduct pitching sessions.

## **Reference Books:**

1. Natasha Evers James Cunningham Thomas Hoholm, Technology Entrepreneurship Bringing Innovation to the Marketplace, Second Edition, Red Globe Press
2. Thomas N. Duening, Robert D. Hisrich, Michael A. Lechter, Technology Entrepreneurship Taking Innovation to the Marketplace, Third Edition, Academic Press, Elsevier
3. Walid O. El Cheikh, Startup Pitching For Every Day Situations at School or Work, A Free Handbook for Students. Workers. Leaders, PITCHIO
4. Mike Kennard, Innovation and Entrepreneurship, Routledge Focus
5. John Bessant and Joe Tidd, Innovation and Entrepreneurship, Third Edition, Wiley

## Thesis/Project

**Course Title:** Thesis/Project  
**Course No:** MIT652  
**Nature of the Course:** Thesis  
**Semester:** IV

**Full Marks:** 200  
**Pass Marks:** 100  
**Credit Hrs:** 8

### Course Description:

This course covers the realization of theoretical and practical concepts of information technology for conducting research relevant to the field of IT. The course focuses on enabling students with the skills related to research methodology. The course includes practicing the abilities pertaining to the design, implementation and analysis of research problem in the domain of information technology.

### Course Objectives:

The main objective of this course is to make students familiar with the concepts of scientific research activities so that students will be able to develop theoretical and practical skills for conducting IT related research works.

### Course Contents:

The course includes execution of research methodology activities during the thesis work. The students will work under supervision of the regular faculties of the program at the department.

### Phases of Thesis/Project:

The following are the phases of thesis/project work:

1. **Proposal Defense:** Students must submit and present project proposal at the beginning of thesis/project work.
2. **Pre-defense/Mid-Defense:** Students must submit progress report and defend progress of their thesis/project work. Every students must qualify mid-defense before final defense. At least two weeks
3. **Final Defense:** Students must submit and defend the thesis/project work at the end for the final qualification. Students have to submit the thesis/project final report to the department before at least 10 days of final defense date. The copy of report should be made available to the external assigned from the Exam Section, IOST before a week of defense date. The students should successfully qualify the viva-voce during final defense.

**Provision of Supervision:**

Supervisor should be the regular faculty of the MIT program. A supervisor can supervise at most five students per section of an academic year intake.

**Evaluation Scheme:**

The evaluation committee and evaluation criteria should be as follow;

**a. Evaluation committee for Proposal Defense**

- A research committee formulated as per the TU IOST rule should evaluate the proposal defense of thesis/project work. Every student should qualify proposal defense before starting thesis/project work.

**b. Evaluation committee for Mid-Defense**

- An evaluation committee with HOD/Director/Coordinator, Supervisor and Internal Examiner should evaluate the mid-defense of the thesis/project work

**c. Evaluation Committee for Final Defense**

- An evaluation committee with HOD/Director/Coordinator, Supervisor, Internal Examiner and External Examiner should evaluate the mid-defense of the thesis/project work.
- The Internal for final defense should be same as that of mid-defense.
- The external examiner should be assigned from the exam section, Dean's Office, IOST, TU.

**d. Evaluation Plan**

<b>S.N.</b>	<b>Description</b>	<b>Full Marks</b>
1	Overall Thesis/Project Work	50
2	Overall Presentation	40
3	Overall Report	40
4	List of Tables, Charts, Groups, Figures/ Captions	10
5	Abstract and Conclusion	20
6	Citations/References	10
7	Viva-Voce	30
<b>Total</b>		<b>200</b>

**e. Marks Allocation for final Defense**

Head/Director/Coordinator	–	200 (10%)=20
Supervisor	–	200 (50%)=100
Internal Examiner	–	200 (15%)=30
External Examiner	–	200 (25%)=50

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**Final Marks = 200**

**Roles and Responsibilities:**

- **HOD/Director/Coordinator:** The role of HOD/Director/Coordinator is to coordinate with supervisor, internal examiner, external examiner and students. The HOD/Director/Coordinator should monitor the students’ project progress in coordination with the respective supervisors. The HOD/Director/Coordinator is responsible for arranging the proposal defense, mid-defense and final defense as well as for plagiarism testing of the reports. The HOD/Director/Coordinator should participate and evaluate proposal defense, midterm, and final defense.
- **Supervisor:** The role of supervisor is to supervise students’ thesis/project. The supervisor should rigorously guide, monitor, and feedback the students. Supervisor should participate and evaluate mid-defense, and final defense.
- **Internal Examiner:** The role of internal examiner is to evaluate the students’ thesis/project during different evaluation phases of the thesis/project. The internal examiner should participate and evaluate mid-defense, and final defense.
- **External Examiner:** The role of external examiner is to evaluate the students’ thesis/project during final defense evaluation.
- **Student:** The role and responsibilities of student include execution of research methodology activities during thesis/project work. Students should prepare thesis/project report and defend the thesis/project work throughout each evaluation phases. Students should qualify all of the evaluations. Students should qualify the plagiarism test of their report as per the IOST plagiarism test rules and regulations.

**Report Contents:**

**1. Contents for the thesis/project proposal**

1. Introduction
2. Problem Statement

3. Objectives
4. Background Study
5. Literature Review
6. Methodology
  - a. Description of Methodology
  - b. Flowcharts Depicting Methodology (If Any)
  - c. Description of Data (If any)
  - d. Description of Algorithms/ Mathematical Models
  - e. Performance / Evaluation Metrics (If any)
7. Working Schedule
8. Expected Outcome
9. References
10. Plagiarism Test Report

## **2. Contents for the thesis/project final report**

1. Cover & Title Page
2. Certificate Page
  - i. Supervisor Recommendation
  - ii. Head / Program Coordinator, Supervisor, Internal and External Examiners' Approval Letter
3. Acknowledgement
4. Plagiarism Test Report
5. Abstract Page
6. Table of Contents
7. List of Abbreviations, List of Figures, List of Tables
8. Main Report
9. References
10. Bibliography (If Any)
11. Appendices (If any)

## **3. Prescribed Units in the main report**

### **1. Unit 1: Introduction**

- 1.1. Introduction
- 1.2. Problem Statement
- 1.3. Objectives
- 1.4. Scope and Limitation
- 1.5. Report Organization

## **2. Unit 2: Background Study and Literature Review**

- 2.1. Background Study
- 2.2. Literature Review

## **3. Unit 3: Methodology**

- 3.1. Description of Methodology
- 3.2. Data Set Description (If Applicable)
- 3.3. Data Preprocessing (If Applicable)
- 3.4. Description of Algorithms/Mathematical Models
- 3.5. Performance/ Evaluation Metrics (If Applicable)

## **4. Unit 4: Implementation**

- 4.1. Tools and Techniques
- 4.2. Implementation Details

## **5. Unit 5: Result and Analysis**

- 5.1. Findings and Observations
- 5.2. Result Analysis

## **6. Unit 6: Conclusion and Future Recommendations**

- 6.1. Conclusion
- 6.2. Future Recommendations

While writing above Units students should avoid basic definitions. Students should relate and contextualize the above mentioned concepts with the respective problem domain during thesis/project work.

### **Citation and Referencing:**

The listing of references should be listed in the references section. The references contain the list of articles, texts, books, web urls, etc. cited in the report. The resources that are studied and referred during the study but not cited in the report should be listed in the bibliography section. The citation and referencing standard should be in IEEE referencing format.

### **Formatting Standards:**

The report can be prepared using a word processor or LATEX. The students are highly recommended to use LATEX. The formatting standards are as below;

### **A. Page Number**

The pages from certificate page to the list of tables should be numbered in roman starting from i.

The pages from Unit 1 onwards should be numbered in numeric starting from 1. The page number should be inserted at bottom, aligned center.

### **B. Page Size and Margin**

The paper size must A4.

The margins must be set as

- Top = 1 inch
- Bottom = 1 inch
- Left = 1.25 inch
- Right = 1 inch

### **C. Paragraph Format**

- All paragraphs must be justified and have spacing of 1.5.

### **D. Text Font and Size**

- The contents in the document should be in Times New Roman font.
- The font size in the paragraphs of report should be 12.
- The font size for the headings should be 16 for Unit headings, 14 for section headings, 12 for sub-section headings. All the headings should be bold faced.

### **E. Figures and Tables**

- Position of figures and tables should be aligned center. The figure caption should be centred below the figure and table captions should be centred above the table. All the captions should be of bold face with 12 font size. The caption numbers for the figures and tables should be the Unit index with required subindex.

### **Report Binding and Submission:**

- Four copies of spiral binding of proposal should be submitted to the department before proposal defense.
- Three copies of spiral binding of mid-defense report should be submitted to the department before mid-defense. The format of mid-defense report is same as the final report.

- Four copies of spiral binding of final report should be submitted to the department before final defense.
- Final Submission

No of Copies: 3 (Library + Self + Dean Office)

Look and Feel: Golden Embracing with Black Binding

A final approved signed copy of the report should be submitted to the Dean Office, Exam Section, Institute of Science and Technology, Tribhuvan University.

**Reference Books: None**

## Social Network Analytics

**Course Title:** Social Network Analytics

**Course No:** MIT653

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

**Semester:** IV

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs.:** 3

### **Course Description:**

This course covers different concepts of social network analysis including introduction, mathematical foundations, research design, data collection and management, multivariate techniques, visualization, testing hypothesis, characterizing whole networks, centrality, subgroups, equivalence, analyzing two-mode data, large networks, and ego networks.

### **Course Objectives:**

The main objective of this course is to make students familiar with different concepts of social network and social network analysis.

### **Course Contents:**

#### **Unit 1: Introduction (2 Hrs.)**

Why networks? What are networks? Types of relations; Goals of analysis; Network variables as explanatory variables; Network variables as outcome variables

#### **Unit 2: Mathematical Foundations (4 Hrs.)**

Introduction; Graphs; Paths and components; Adjacency matrices; Ways and modes; Matrix products

#### **Unit 3: Research Design (5 Hrs.)**

Introduction; Experiments and field studies; Whole-network and personal-network research designs; Sources of network data; Types of nodes and types of ties; Actor attributes; Sampling and bounding; Sources of data reliability and validity issues; Ethical considerations

#### **Unit 4: Data Collection and Management (5 Hrs.)**

Data Collection: Introduction; Network questions; Question formats; Interviewee burden; Data collection and reliability; Archival data collection; Data from electronic sources

Data Management: Introduction; Data import; Cleaning network data; Data transformation; Normalization; Cognitive social structure data; Matching attributes and networks; Converting attributes to matrices; Data export

#### **Unit 5: Multivariate Techniques Used in Network Analysis (4 Hrs.)**

Introduction; Multidimensional scaling; Correspondence analysis; Hierarchical clustering

**Unit 6: Visualization (3 Hrs.)**

Introduction; Layout; Embedding node attributes; Node filtering; Ego networks; Embedding tie characteristics; Visualizing network change; Exporting visualizations

**Unit 7: Testing Hypotheses (4 Hrs.)**

Introduction; Permutation tests; Dyadic hypotheses; Mixed dyadic–monadic hypotheses; Node-level hypotheses; Whole-network hypotheses; Exponential random graph models; Stochastic actor-oriented models (SAOMs)

**Unit 8: Characterizing Whole Networks (3 Hrs.)**

Introduction; Cohesion; Reciprocity; Transitivity and the clustering coefficient; Triad census; Centralization and core–periphery indices

**Unit 9: Centrality, Subgroups and Equivalence (7 Hrs.)**

Centrality: Introduction; Basic concept; Undirected, non-valued networks; Directed, non-valued networks; Valued networks; Negative tie networks

Subgroups: Introduction; Cliques; Girvan–Newman algorithm; Factions and modularity optimization; Directed and valued data; Computational considerations; Performing a cohesive subgraph analysis; Supplementary material

Equivalence: Introduction; Structural equivalence; Profile similarity; Blockmodels; The direct method; Regular equivalence; The REGE algorithm; Core–periphery models

**Unit 10: Analyzing Two-mode Data (4 Hrs.)**

Introduction; Converting to one-mode data; Converting valued two-mode matrices to one-mode; Bipartite networks; Cohesive subgroups and community detection; Core–periphery models; Equivalence

**Unit 11: Large Networks and Ego Networks (4 Hrs.)**

Large Networks: Introduction, Reducing the size of the problem, Choosing appropriate methods, Sampling, Small-world and scale-free networks; Ego Networks: Introduction; Personal-network data collection; Analyzing ego network data

**Laboratory Work:**

Students should implement and realize social network analysis using appropriate tools and languages.

**References:**

4. Stephen P Borgatti, Martin G Everett and Jeffrey C Johnson, *Analyzing Social Networks*, SAGE, 2<sup>nd</sup> Edition, 2018
5. Song Yang, Franziska B Keller, Lu Zheng, *Social Network Analysis: Methods and Examples*, Sage Publications (Verlag), 2016

6. Krishna Raj P.M., Ankith Mohan, Srinivasa K.G., Practical Social Network Analysis with Python, Springer, Year: 2018
7. Mehmet Kaya, Jalal Kawash, Suheil Khoury, Min-Yuh Day, Social Network Based Big Data Analysis and Applications, Springer International Publishing, 2018
8. Reda Alhajj, Jon Rokne, Encyclopedia of Social Network Analysis and Mining, Springer New York, 2018
9. Xiaoming Fu, Jar-Der Luo, Margarete Boos, Social Network Analysis: Interdisciplinary Approaches and Case Studies, CRC Press, 2017

## Software Testing

**Course Title:** Software Testing

**Course No:** MIT654

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

**Semester:** IV

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs:** 3

### Course Description:

This course is a comprehensive course with a solid foundation in software testing principles and practices. The course emphasizes a model-driven approach to test design, ensuring that students can systematically create and execute tests to validate software behavior. This course prepares students for real-world software testing challenges, fostering a deep understanding of both the theoretical and practical aspects of the field.

### Course Objectives:

The main objective of this course is to make students equipped with the knowledge and skills to design effective test cases and plans, implement various testing techniques and coverage criteria, use automated tools to enhance the efficiency of testing processes and ensure high-quality software through rigorous testing methodologies.

### Course Contents:

#### Unit 1: Introduction/Foundations (5 Hrs.)

Why Do We Test Software?: When Software Goes Bad, Goals of Testing Software; Model-Driven Test Design: Software Testing Foundations, Software Testing Activities, Testing Levels Based on Software Activity, Coverage Criteria, Model-Driven Test Design, Why MDTD Matters

#### Unit 2: Test Automation and Putting Testing First (6 Hrs.)

Test Automation: Software Testability, Components of a Test Case, A Test Automation Framework, Beyond Test Automation; Putting Testing First: Taming the Cost-of-Change Curve, The Test Harness as Guardian

#### Unit 3: Criteria-Based Test Design (3 Hrs.)

Coverage Criteria Defined, Infeasibility and Subsumption, Advantages of Using Coverage Criteria, Next Up

#### Unit 4: Input Space Partitioning and Domain Testing (10 Hrs.)

Input Space Partitioning: Input Domain Modeling, Combination Strategies Criteria, Handling Constraints among Characteristics, Extended Example: Deriving an IDM from JavaDoc; Domain Testing: Equivalence Partitioning, Domain Analysis, Optimized Domain Testing (ODT), ODT at Different Abstraction Levels

**Unit 5: Graph Coverage and Logic Coverage (7 Hrs.)**

Graph Coverage: Overview, Graph Coverage Criteria, Graph Coverage for Source Code, Graph Coverage for Design Elements, Graph Coverage for Specifications, Graph Coverage for Use Cases; Logic Coverage: Semantic Logic Coverage Criteria (Active), Syntactic Logic Coverage Criteria (DNF), Structural Logic Coverage of Programs, Specification-Based Logic Coverage, Logic Coverage of Finite State Machines

**Unit 6: Syntax-Based Testing (3 Hrs.)**

Syntax-Based Coverage Criteria, Program-Based Grammars, Integration and Object-Oriented Testing, Specification-Based Grammars, Input Space Grammars

**Unit 7: Managing the Test Process (3 Hrs.)**

Overview, Requirements Analysis and Specification, System and Software Design, Intermediate Design, Detailed Design, Implementation, Integration, System Deployment, Operation and Maintenance, Implementing the Test Process

**Unit 8: Writing Test Plans and Test Implementation (5 Hrs.)**

Writing Test Plans: Level Test Plan Example Template; Test Implementation: Integration Order, Test Doubles

**Unit 9: Writing Effective Test Oracles (3 Hrs.)**

What Should Be Checked? Determining Correct Values

**Laboratory Work:**

Students should implement test frameworks and include exercises with tailored tools for self-checking.

**References:**

- Paul Ammann and Jeff Offutt, Introduction to Software Testing, 2<sup>nd</sup> Edition, 2017
- James A. Whittaker, Exploratory Software Testing: Tips, Tricks, Tours, and Techniques to Guide Test Design, 2011
- István Forgács and Attila Kovács, Modern Software Testing Techniques: A Practical Guide for Developers and Testers, 2024
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## Network and System Administration

**Course Title:** Network and System Administration

**Course No:** MIT655

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

**Semester:** IV

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs.:** 3

### **Course Description:**

This course will provide aspects of managing and automating data center services, focusing on scalable solutions and efficient system administration. It provides an in-depth understanding of both the technology and methodologies involved in system administration.

### **Course Objectives:**

The primary objective of this course is to equip students with the knowledge and skills to effectively manage and automate data center services, handle network and system administration complexities, and apply security and policy-based management.

### **Course Contents:**

#### **Unit 1: Introduction (4 Hrs.)**

Scaling data center services, Automating system administration: Landscape, approaches and costs, System configuration management

#### **Unit 2: The Technology (6 Hrs.)**

Unix and z/OS, Email, XML-based network management, Open technology, System backup: Methodologies, algorithms and efficiency models, What can Web services bring to integrated management?, Internet management protocols

#### **Unit 3: Networks, Connections and Knowledge (10 Hrs.)**

Management of ad-hoc networks, some relevant aspects of network analysis and graph theory, Knowledge engineering using ontologies, Application integration using semantic Web services

#### **Unit 4: Policy and Constraint (4 Hrs.)**

Security management and policies, Policy-based management

#### **Unit 5: Computational Theories of System Administration (6 Hrs.)**

On the complexity of change and configuration management, Complexity of system configuration management, Predictable and reliable program code: Virtual machine-based projection semantics

#### **Unit 6: System Science (5 Hrs.)**

System administration and the scientific method, System administration and micro-economic modeling, System reliability

#### **Unit 7: Business and Services (6 Hrs.)**

State-of-the-art in economic management of internet services, Service provisioning: Challenges, process alignment and tool support, IT service management, Decision and control factors for IT-sourcing, how do ICT professionals perceive outsourcing? Factors that influence the success of ICT outsourcing

**Unit 8: Professional and Social Issues (4 Hrs.)**

Systems administration as a self-organizing system: The professionalization of SA via interest and advocacy groups, Ethical, legal and social aspects of systems

**Laboratory Work:**

Students should implement and realize of system and network analysis techniques and tools using Linux which should include network and firewall configuration, DNS and DHCP configuration and troubleshooting, mail server, web and proxy server configuration and troubleshooting.

**References:**

1. Jan Bergstra, Mark Burgess, Handbook of Network and System Administration, 2008
2. Roderick W. Smith, Advanced Linux Networking, Addison-Wesley Professional, Pearson Education, 2002.
3. Tony Bautts, Terry Dawson, Gregor N. Purdy, O'Reilly, Linux Network Administrator's Guide, Third Edition, 2005

## Web Technology

**Course Title:** Web Technology

**Course No:** MIT656

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

**Semester:** IV

**Full Marks:** 45+30

**Pass Marks:** 22.5+15

**Credit Hrs:** 3

### **Course Description:**

This course is designed to take students from beginner to advanced levels in developing web applications using the Django framework. Django is a high-level Python web framework that promotes rapid development and clean, pragmatic design. This course covers all the essential aspects of Django, including models, views, templates, forms, authentication, and deployment, as well as advanced topics such as caching. Through hands-on projects and real-world examples, students will gain practical experience and a deep understanding of how to build robust, scalable web applications.

### **Course Objectives:**

By the end of this course, participants will be able to Create and Manage Django Projects and Apps, Work with Databases and Models, Handle Forms and User Input, implement authentication and authorization features, and Test and Deploy Django Applications:

### **Unit 1: Django Basics (7 Hrs.)**

Web Framework, MVC Design Pattern, Django Features, Setting Up a Database, Starting a Project, Dynamic Web Pages, Dynamic Content, Mapping URLs to Views, How Django Processes a Request, URLconfs and Loose Coupling, 404 Errors, Dynamic URLs, Django's Pretty Error, The Django Template System, Using the Template System, Basic Template Tags and Filters, Templates in Views, Template Loading, Template Inheritance.

### **Unit 2: Model, Administration Site and Form Processing (9 Hrs.)**

The Dumb Way to Do Database Queries in Views, The MTV Development Pattern, Configuring the Database, First App, Defining Models in Python, First Model, Installing the Model, Data Access, Adding Model String Representations, Inserting and Updating Data, Selecting Objects, Filtering Data, Deleting Objects, Making Changes to a Database Schema, Activating the Admin Interface, Using the Admin Interface, Customizing the Admin Interface, Customizing the Admin Interface's Look and Feel. Customizing the Admin Index Page, Search, The Perfect Form, Creating a Feedback Form, Processing the Submission, Custom Validation Rules, Custom Look and Feel, Creating Forms from Models.

### **Unit 3: Views, URLConfs, Template Engine and Non-HTML Content (7 Hrs.)**

URLconf Tricks, Including Other URLconfs, Using Generic Views, Generic Views of Objects, Extending Generic Views, Template Language Review, Request Context and Context Processors,

Inside Template Loading, Extending the Template System, Writing Custom Template Loaders, Using the Built-in Template Reference, Configuring the Template System in Standalone Mode, The basics: views and MIME-types, Producing CSV, Generating PDFs, Other Possibilities, The Syndication Feed Framework, The Sitemap Framework.

#### **Unit 4: Users, caching and Subframework (7 Hrs.)**

Cookies, Django's Session Framework, Users and Authentication, The Other Bits: Permissions, Groups, Messages, and Profiles, Setting Up the Cache, The Per-Site Cache, The Per-View Cache, The Low-Level Cache API, Upstream Caches, Other Optimizations, Order of Middleware Classes, The Django Standard Library, Sites, Flatpages, Redirects, CSRF Protection, Humanizing Data, Markup Filters,

#### **Unit 5: Middleware, Legacy Databases and Admin Interface (7 Hrs.)**

Middleware Overview, Middleware Installation, Middleware Methods, Built-in Middleware, Integrating with a Legacy Database, Integrating with an Authentication System, Integrating with Legacy Web Applications, The Zen of Admin, Customizing Admin Templates, Creating Custom Admin Views, Creating Custom Admin Views, Overriding Built-in Views

#### **Unit 6: Internationalization, Security and Deployment (8 Hrs.)**

Specifying Translation Strings in Python Code, Specifying Translation Strings in Template Code, Creating Language Files, Language Preference Discovery, The set language Redirect View, Using Translations in Projects, Translations and JavaScript, Web Security theme, SQL Injection attack, XSS, Cross-Site Request Forgery, Session Forging/Hijacking, Email Header Injection, Directory Traversal, Exposed Error Messages, Shared Nothing, Personal Preferences, Using Django with Apache and mod\_python, Using Django with FastCGI, Scaling, Performance Tuning.

#### **Laboratory Works:**

Students need to write python programs to demonstrate every concept taught in classroom and should also develop a web app using Django.

#### **References:**

1. Adrian Holovaty, Jacob K. Moss, The Definitive Guide to Django: Web Development Done Right, Apress, Second Edition, 2009.
2. William S. Vincent, Django for Beginners: Build websites with Python and Django by, WelcomeToCode, First Edition 2023.

## **International Business**

**Course Title:** International Business

**Course No:** MIT657

**Nature of the Course:** Theory

**Semester:** IV

**Full Marks:** 45 + 30

**Pass Marks:** 22.5 + 15

**Credit Hrs.:** 3

### **Course Description:**

International Business equips students with the knowledge and skills to manage and lead in a global business environment. The course explicitly leverages information technology to enhance international operations. It integrates theory with practical applications to prepare students for careers in multinational corporations, international organizations, and global IT firms.

### **Course Objectives:**

The general objective of this course is to familiarize students with the various concepts of international business and its management. More specifically, the course will empower students to understand the complexities of international business operations, critically assess global economic, political, and regulatory environments affecting businesses, analyze and evaluate global market opportunities and challenges, develop leadership skills in cross-cultural management and communication, apply information technology solutions to optimize global business processes, design and implement international business strategies using IT frameworks and tools.

### **Course Contents:**

#### **Unit 1: Introduction to International Business Management (3 Hrs.)**

Globalization and its impact on business; Cultural dimensions in international business; Ethical considerations in global business practices

#### **Unit 2: Global Business Strategy (6 Hrs.)**

Strategic management in an international context; Entry modes and expansion strategies; Managing global alliances and partnerships

#### **Unit 3: International Marketing (8 Hrs.)**

Global marketing strategies and segmentation; Branding and positioning in international markets; Digital marketing; and e-commerce across borders

#### **Unit 4: Cross-cultural Management (5 Hrs.)**

Managing multicultural teams and diversity; Communication strategies in international business; Negotiation and conflict resolution in global contexts.

**Unit 5: International Finance and Accounting (8 Hrs.)**

Foreign exchange management and risk; Financial strategies for multinational corporations; International taxation and financial reporting

**Unit 6: Information Technology in International Business (5 Hrs.)**

Role of IT in global supply chain management; Enterprise resource planning (ERP) systems in global operations; Cybersecurity and data privacy in international settings

**Unit 7: Case Studies and Practical Applications (10 Hrs.)**

Analysis of real-world international business cases; Simulation exercises in global business decision-making; Industry projects with multinational corporations

**References:**

1. Charles W. L. Hill and G. Tomas M. Hult, *International Business: Competing in the Global Marketplace*, 14<sup>th</sup> Edition, McGraw Hills, 2023.
2. Helen Deresky and Stewart R. Miller, *International Management: Managing Across Borders and Cultures*, 10<sup>th</sup> Edition, Pearson, 2021.
3. Warren J. Keegan and Mark C. Green, *Global Marketing Management*, 7<sup>th</sup> Edition, Pearson, 2022.
4. Jeff Madura, *International Financial Management*, 13th Edition, Cengage Learning, 2018.
5. Philippe-Pierre Dornier, Ricardo Ernst, Michel Fender, and Panos Kouvelis, *Global Operations and Logistics: Text and Cases*, WSE, 2008.