# Indian Institute of Information Technology, Bhopal

**Department of Information Technology**


Syllabus

For

# Post Graduate Programme

# Master of Computer Applications (MCA)

# (3 Years)

# 1st Semester

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | First |
| **Course Name** | Fundamental of Computer Programming |
| **Course Code** | MCA-1001 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the need to learn new languages to solve complex problems in different domains.
2. To provide fundamentals of computers and understand the use of software, compiler, and programming language.
3. To understand the basic concepts of input, output, control statements, arrays, strings, functions, pointers, and structures for problem-solving using programming.

**Course Content**

**Module 1. Fundamentals of Programming**: Brief History of Computing and Computers, Basic Organization of Computer, Representing Information as Bit Patterns, Number System, Basics of Computer Languages, Generation of Programming Languages, Compilers, Interpreter, Programming Environments and Debugging, Types of Errors and Debugging Techniques, Problem-Solving Aspects, Introduction to Algorithms, Flowcharts, Pseudocode.

**Module 2. Basic Programming and Control Statements:** Structure of C Program, Life Cycle of Program from Source Code to Executable, Keywords, Identifiers, Primitive Data Types in C, Variables, Constants, Input/output Statements in C, Operators, Type Conversion and Type Casting, Conditional Branching Statements, Iterative Statements, Nested Loops, Break and Continue Statements.

**Module 3. Modular Programming and Recursion:** Functions, Declaration, Definition, Call and Return, Call by Value, Call by Reference, Showcase Stack Usage with help of Debugger, Scope of Variables, Storage Classes, Recursive Functions, Recursion vs Iteration.

**Module 4. Array-based Programming:** Arrays, One-dimensional, Two Dimensional, and Multidimensional Arrays, Operations on Array, Traversal, Insertion, Deletion, Merging and

Searching, Inter-Function Communication via Arrays, Passing a Row, Passing the Entire Array, Matrices, Strings, Read Operation, Writing and Manipulating Strings.

**Module 5. C Pointers, DMA and Structure:** Pointers, Understanding Computer Memory, Accessing via Pointers, Pointers to Arrays, Drawback of Pointers, Dynamic Memory Allocation, Structures, and Unions.

**Module 6. File in C Programming:** File Handling, File Redirection, File Pointers, Preprocessor, Library Functions, Low-Level Programming.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Understand the basic terminology and program structures used in computer programming to solve real-world problems.

**CO 2:** Apply the process of representing problems and writing, compiling, and debugging programs.

**CO 3:** Develop programming skills in using different data types, decision structures, loop functions, pointers, data files, and dynamic memory allocation/deallocation.

**List of Textbooks**


1. Byron S Gottfried, Programming with C, 4th Edition, (Schaum's Outlines) Paperback, McGraw Hill Education, 2018.
2. Herbert Schildt, C: The Complete Reference, 4th edition, McGraw Hill Education (India) Private Limited, Noida, Uttar Pradesh, 2017.
3. E. Balaguruswamy, Programming in ANSI C, Eighth edition, McGraw Hill Education (India) Private Limited, Noida, Uttar Pradesh, 2019.


**List of Reference Books**


1. Kernighan, B.W. and D. M. Ritchie, The C Programming Language, 2nd ed., Pearson Education India, 2015.
2. Yashavant Kanetkar, Let Us C: Authentic Guide to C Programming Language (18th Edition), BPB Publications, India, 2021.
3. King K. N, C Programming: A Modern Approach, 2nd ed., W. W. Norton & Company, 2008.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | First |
| **Course Name** | Discrete Mathematics |
| **Course Code** | MCA-1002 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand concept of set theory.
2. To develop critical thinking and problem-solving skills through various exercises and assignments.
3. To apply discrete mathematics concepts in other fields, such as computer science, engineering, and data science.

**Course Content**

**Module 1:Sets:** Methods for describing a set, e.g., listing elements, set builder notation, Venn diagrams, Union, intersection, set difference, complement, Cartesian product, Power sets, Cardinality of finite sets, Inclusion-exclusion principle, Proof Technique: Mathematical Induction.

**Module 2: Relations:** Reflexivity, symmetry, antisymmetric, transitivity, Equivalence relations, Equivalence class, Functions: Domain, target, and range/image of a function, Surjections, injections, bijections, Inverses, Composition, Partial Ordering sets, Linear Ordering, Hasse Diagrams, Maximum and Minimum elements. Lattices, The pigeonhole principle. Algebraic Structure: Group, Ring, Field.

**Module 3:Basic Logic:** Propositional logic, Logical connectives, Truth tables, Tautology and Contradiction, Disjunctive normal form, Conjunctive normal form, Validity of a well-formed formula, Propositional inference rules (e.g., modus ponens, modus), Universal and existential quantifiers and their negations.

**Module 4: Trees and Graphs:** Trees, Properties of the tree, Traversal strategies. Introduction to Graphs and their basic properties: degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, graph coloring, planar graph. Undirected graphs, directed graphs, weighted graphs, spanning tree, Spanning tree algorithms, forests, Graph isomorphism. Graph coloring,

covering, and Partitioning. Bipartite graph, chromatic number, Chromatic Partitioning, Chromatic Polynomial, matching, covering – four color problems.

**Module 5: Recurrence Relations:** Definition of recurrence relations, Formulating recurrence relations, Linear homogeneous recurrence relations with constant coefficients. Solving linear homogeneous recurrence relations with constant coefficients of degree two when the characteristic equation has distinct roots and only one root, Particular solutions of nonlinear homogeneous recurrence relation, Solution of recurrence relation by the method of generation functions.

**Course Outcomes**

On successful completion of the course, students should be able to:

**CO 1:** Describe the basic principles of sets and operations in sets.
**CO 2:** Determine the properties of relations and functions.
**CO 3:** Define basic notions in graph theory and chromatic graph theory.
**CO 4:** Demonstrate different traversal methods for trees and graphs.

**List of Text Books**


1. Rosen, Kenneth H., Krithivasan, Kamala. Discrete Mathematics and Its Applications. Singapore: McGraw-Hill, 2013.
2. Richard Johnsonbaugh, Discrete Mathematics, 8th Edition. DePaul University, Chicago, Pearson, 2017.
3. C. L. Liu, Elements of Discrete Mathematics (SIE), 3rd Edition. Tata McGraw Hill India, 2008. .


**List of Reference Books**


1. Oscar Levin, Discrete Mathematics: An Open Introduction. Independently Published, 2018.
2. Norman Biggs, Discrete Mathematics, Illustrated Reprint Edition. OUP Oxford, 2002.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | First |
| **Course Name** | Computer Organization and Architecture |
| **Course Code** | MCA-1003 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the basics of computer hardware and how software interacts with computer hardware.
2. To provide an overview of the design principles of digital computing systems.
3. To gain a better understanding of how data is represented and manipulated by machines.
4. To understand how computations are performed at the level of the machine.

**Course Content**

**Module 1: Overview of Computer Architecture and Organization:** Contrast between computer architecture and organization, Fundamentals of computer architecture, Organization of von Neumann machine. Computers Classification: Micro, Mini, Mainframe and Super Computer. System Bus and Interconnection, Structure of IAS. Fundamental Concepts: Fetching and storing a word in Memory, Register Transfer.

**Module 2: Computer Arithmetic and Machine Instruction:** Control word, Stack Organization, Register Stack, Memory Stack, Instruction Format: Three Address, Two Address, One Address and Zero Address Instruction, Addressing Modes: Types of Addressing modes, Numerical Examples, Program Relocation, Compaction.

**Module 3: Data Transfer & Manipulation:** Data transfer, Data Manipulation, Arithmetic, Logical & Bit Manipulation Instruction, Program Control: Conditional Branch Instruction, Subroutine, Program Interrupt, Types of Interrupt, I-Cycle, Interrupt and Class of Interrupts. RISC & CISC Characteristic. Control Unit Design**:** Instruction sequencing, Instruction interpretation, control memory, Hardwired Control, Micro programmed Control, Micro programmed Computers.

**Module 4: I/O Organization:** Bus control, Serial I/O, Asynchronous and synchronous modes, Program controlled: Asynchronous, synchronous & Interrupt driven modes, DMA mode,

interrupt controller and DMA controller. Memory System Organization and Architecture**:** Memory system hierarchy, main memory organization, cache memory, virtual memory.

**Module 5: Intel 8085:** Functional Block Diagram, Pin Configuration, Description of each Block: Registers, Flag, Data and Address Bus including Bidirectional Address/Data Bus, Timing and Control Unit, Interrupts, Instructions: Op-Code and Operands Addressing Modes, Instructions and Data Flow, Basic Assembly Language Programming using 8085 Instruction Sets Addition, Subtraction, Multiplication and Division, Simple Sequence Programs.

**Course Outcomes**

On successful completion of the course, students should be able to:

**CO 1:** List the different types of memory and distinguish them.
**CO 2:** Analyze the abstraction of various components of a computer.
**CO 3:** Discriminate the various functional units of CPU and illustrate functioning of I/O devices.
**CO 4:** Explain latest processor technologies and evaluate systems for one's own requirements.

**List of Text Books**


1. D. A. Pattersen and J. L. Hennesy, Computer Computer Architecture: A Quantitative Approach, 6th Edition, Morgan Kaufman, 2019.
2. William Stalling, Computer Organization & Architecture, 11th Edition. Pearson Education, 2022.
3. Mano M. Morris, Computer System Architecture, 3rd Edition. Pearson Education, 2017.


**List of Reference Books**


1. D. A. Pattersen and J. L. Hennesy, Computer Organisation and Design, MIPS Edition: The Hardware/ Software Interface, 6th Edition, Morgan Kaufman, 2020.
2. Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, 6th Edition, Penram International Publishing, 2013.
3. V. P. Heuring and H. F. Jordan, Computer System Design and Architecture, Prentice Hall, 2003.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | First |
| **Course Name** | Operating System |
| **Course Code** | MCA-1004 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the services and design of an operating system.
2. To understand the structure and organization of the file system.
3. To understand the process states and various related concepts such as scheduling and synchronization.
4. To understand different memory management approaches.

**Course Content**

**Module 1: Evolution of OS:** The Evolution of Operating Systems (OS), Fundamental goals of operating systems overview of essential features of OS operation. Overview of OS: multiprogramming, Batch, interactive, time sharing, distributed and real-time operating systems; Concurrency and parallelism.

**Module 2: Process Management and Scheduling:** Concept of process and process synchronization, process states, process state transitions, the process control block, operations on processes, suspend and resume, interrupt processing, mutual exclusion, the producer/consumer problem, the critical section problem, semaphores, classical problems in concurrency, inter-process communication; Issues in user service and system performance.

**Module 3: Process Synchronization and Deadlocks:** Synchronization primitives and problems, deadlocks (essential topics: Peterson's algorithm, monitors), detection and prevention of deadlocks, dynamic resource allocation.

**Module 4: Memory Management:** Memory fragmentation and techniques for memory reuse paging, virtual memory management using paging, Segmentation, Distributed and Multiprocessor Systems.

**Module 5: File Management:** File systems, implementation of file Operations. Protection of files.

**Course Outcomes**

At the end of the course, the student will be able to:

**CO 1:** Describe functional architecture of operating system

**CO 2:** Describe process concept and its implementation, compare process scheduling algorithms.

**CO 3:** Classify memory management schemes and compare them on the basis of related advantages and disadvantages.

**CO 4:** Describe Process synchronization mechanisms used to solve synchronization problems, describe mechanisms for handling Deadlock problems.

**List of Text Books**


1. A.Silberschatz, Galvin, B.Peter, G. Gagne, Operating System Concepts. 10th Edition, United Kingdom: Wiley, 2021.
2. A.S. Tanenbaum, H. Bos, Modern Operating Systems, 5th Edition. United Kingdom: Pearson Education, 2023.


**List of Reference Books**


1. W. Stallings, Operating Systems: Internals and Design Principles, 9th Edition. United Kingdom: Pearson Education, 2018.
2. D.Comer, Operating System Design: The Xinu Approach, Second Edition. United States: CRC Press, 2015.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | First |
| **Course Name** | Fundamentals of Management |
| **Course Code** | MCA-1005 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the basic principles of management.
2. To gain knowledge about planning, organizing, leading and controlling.
3. To acquaint students with the terms, concepts, and points of view used in management.
4. To comprehend both short and long-term plans in order to successfully achieve organizational goals.

**Course Content**

**Module 1. Introduction to Management :** Fundamentals of management, Nature and scope, Skills and roles of management, Functions, Levels of management, Challenges of management, Evolution of management, Classical approach, Scientific and administrative management.

**Module 2. Planning and Decision Making :** General framework for planning, Types of plans, Management by objectives, Development of business strategy, Programmed and non-programmed decisions, Steps in problem Solving and decision making, Bounded rationality and influences on decision making, Group problem solving, Creativity and innovation in work.

**Module 3. Organization and Human Resource Management:** Principles of organization, Organizational design & structures, Departmentalization, Delegation, Empowerment, Centralization, Decentralization, Recentralization, Organizational culture, Organizational climate and organizational change, Human resource management, Business strategy, Talent management, Models and strategic human resource planning, Recruitment and selection, Training and development.

**Module 4. Leading and Motivation :**Leadership, Power and authority, Leadership styles, Behavioral leadership, Situational leadership, Leadership skills, Leader as mentor and coach, Leadership during adversity and crisis, Handling employee and customer complaints, Team motivation, Types of motivation, Understanding work teams, Motivation, Leadership and

communication and Interpersonal skills, Relationship between motivation, Performance and engagement, Content motivational theories.

**Module 5. Controlling:** Concept, Types and strategies for control, Steps in control process, Budgetary and Non- Budgetary controls, Planning, control relationship, Control techniques Characteristics of team.

**Course Outcomes**

At the end of this course students will be able to :

**CO 1:** Understand critically and strategically about management theories and issues.
**CO 2:** Develop their decision-making and analytical skills.
**CO 3:** Implement leadership and motivational skills.
**CO 4:** Apply control strategies and techniques.

**List of Text Books**


1. S. W. Lowe, Fundamentals of Risk Management: M67: 2023-24 Study Text. United Kingdom: Chartered Insurance Institute, 2023.
2. D. S Bright, A. H. Cortes, Principles of Management. Ukraine: Open Stax Textbooks, 2022.
3. D. Marlon, M. La Rosa. J. Mendling, A. Reijers, Hajo, Fundamentals of Business Process Management. Germany: Springer Berlin Heidelberg, 2018.
4. Robbins,Fundamentals of Management, 9th edition,Pearson Education India,2016
5. H. Koontz, H. Weihrich, Essentials of Management: An International, Innovation and Leadership Perspective, 10th edition, McGraw Hill, 2015.


**List of Reference Books**


1. P. Kotler, K. Lane Keller, Marketing Management, 3rd edition, 2016.
2. S. P. Robbins, R. Bergman, I. Stagg, M. Coulter, Management 7, Prentice Hall, 7th edition, 2015.
3. F. Eugene Brigham, C. Michael Ehrhardt, Financial Mangement: Theory and Practice, SouthWestern College Pub, 15th edition, 2016.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | First |
| **Course Name** | Problem Solving Lab using Python |
| **Course Code** | MCA-1006 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To introduce the Python programming language and its features.
2. To familiarize with basic data structures and algorithms.
3. To enhance ability for clear, organized and efficient coding.

**Course Content**

**Module 1: Basic Python Programming:** Understand Python syntax and its role in programming, write simple Python programs using variables, loops, and conditionals, apply Python coding conventions for readability and maintainability.

**Module 2: Functions and Modular Programming:** Define functions with parameters and return values, utilize functions to encapsulate code and enhance reusability, implement modular programming to organize and structure code.

**Module 3: Data Manipulation and Structures:** Manipulate strings, lists, tuples, and dictionaries effectively, perform operations on data structures to solve practical problems, apply built-in functions for data transformation and manipulation.

**Module 4: Algorithms and Problem Solving:** Develop algorithmic thinking and problem-solving skills, analyze problem statements and design algorithmic solutions, implement algorithms for searching, sorting, and other tasks.

**Module 5: Application Development and Libraries:** Develop small-scale applications using Python, utilize Python libraries and modules to add functionalities, integrate external libraries for tasks like data visualization.

**Module 6: Project and Practical Applications:** Apply concepts learned throughout the course to design and implement a Python project, Develop a complete Python program that solves a real-world problem or simulates a scenario, Present and demonstrate the project, showcasing proficiency in Python programming.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Learn problem-solving skills for working on programming tasks and challenges.
**CO 2:** Demonstrate proficiency in writing, debugging, and optimizing code.
**CO 3:** Use python libraries and frameworks for different applications.

**List of Text Books**


1. Harry R Lewis and Christos H Papadimitriou, Elements of the Theory of Computation, Prentice Hall of India, Pearson Education, New Delhi, 2003.
2. Krithivasan, K., Introduction to Formal Languages, Automata Theory and Computation. India: Pearson Education, 2009.


**List of Reference Books**


1. Wes McKinney, “Python for Data Analysis", O'Reilly Media, 2nd Edition, 2017.

# 2nd Semester

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Application (MCA) |
| **Year** | First |
| **Semester** | Second |
| **Course Name** | Data Structure and Algorithms |
| **Course Code** | MCA-2001 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

Fundamentals of Computer Programming using C (MCA-2001)

**Course Learning Objectives**

1. To explain how to analyze the time and space complexity of an algorithm and how to choose the most efficient algorithm for a given problem.
2. To develop an understanding of basic data structures, algorithms, and their underlying principles.
3. To learn various algorithm design techniques, such as divide and conquer, greedy algorithms, and dynamic programming, and apply them to real-world problems.

**Course Content**

**Module 1. Introduction of Data Structure:** Abstract data types, data representation, elementary data types, algorithm analysis and asymptotic notations, Arrays- types of Arrays, Array based List implementation, Linked list- representation and operations of Linked lists, types of Linked list, Recursion- linear, binary, and multiple recursions.

**Module 2**. **Stack and Queue Data Structure:** Stacks- representation of Stacks and basic operations, applications of Stacks, Prefix, Postfix and Infix notations and conversion, Recursion, Queues types of Queues and its application, implementation of Stack and Queue using Linked list

**Module 3. Search Structures:** Trees- Ordinary and Binary trees terminology, properties of binary trees, binary tree ADT, representations, recursive and non-recursive traversals, binary search trees, AVL trees, 2-3 trees, 2-3-4 trees, Red-black trees, B-trees. Graphs- Graphs terminology, Graph ADT, representations, graph traversals/search methods-DFS and BFS, applications of Graphs-Minimum cost spanning tree using Kruskal's and Prim's algorithm, Dijkstra's algorithm for Single Source Shortest Path Problem.

**Module 4. Searching and Sorting:** Linear and binary search methods, review of hashing, hash function, collision resolution techniques in hashing, separate chaining, open addressing, linear probing, quadratic probing, double hashing, rehashing, extendible hashing. Sorting –bubble sort, insertion sort, quick sort, merge sort, heap sort, radix sort, comparison of sorting methods.

**Module 5. Algorithmic Paradigms:** Greedy Strategy, Dynamic programming, Backtracking, Branch-and-Bound, Randomized algorithms.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Analyze the efficiency of an algorithm based on space and time complexity.
**CO 2:** Able to choose appropriate data structures to represent data items.
**CO 3:** Understand different techniques for solving problems like sorting and searching

**List of Text Books**


1. E. Horowitz, S.Sahni, Fundamentals of Data Structures In C. India: Orient BlackSwan, 2012.
2. Cormen, H.Thomas,Leiserson, E.Charles,Rivest, L.Ronald, C. Stein, Introduction to Algorithms Third Edition. United States: MIT Press, 2009.


**List of Reference Books**


1. M. A. Weiss, Data Structures and Algorithm Analysis in C++ Fourth Edition, Pearson, 2014.
2. M. T. Goodriche, R. Tamassia, Data Structures and Algorithms in C++, Second Edition, John Wiley & Sons, 2011.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | Second |
| **Course Name** | Numerical Analysis |
| **Course Code** | MCA-2002 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the computational details behind the numerical methods.
2. To learn alternate methods of solution better suited to the capabilities of computers.
3. To use the optimality conditions to search for a local or global solution from a starting point.
4. To formulate the dual problem of some general optimization types and assess their duality gap using concepts of strong and weak duality.

**Course Content**

**Module 1. Number Systems and Errors:** Conversion between Different Number Systems, Floating Point Representation, Definitions of Error, Round-off Errors.

**Module 2. Elements of Numerical Linear Algebra:** Direct Methods for Solving Systems of Linear Equations -Iterative Methods, Triangular systems, Gaussian elimination, Pivoting strategies. Gauss-Jordan method, Matrix inversion, Triangular factorization. Iterative Methods-Jacobi method, Gauss-Seidel method.

**Module 3. Solving Equations & Polynomial Interpolation:** Fixed Point Method, Bracketing Methods-Bisection method, Regula-falsi method, Newton's Method, Secant Method, Polynomial Interpolation-Forms of Polynomials, Polynomial Interpolation Methods, Lagrange method, The method of undetermined coefficients, Newton's method.

**Module 4. Numerical Integration & Numerical Solution of Differential Equations:** Trapezoidal Rule, Simpson's Rule, Composite Simpson's rule, Approximate Sums, Solution of a Differential Equation by Taylor Series and Picard's Methods, Euler's Method, Discretization Error, Runge's Methods of second-order and third-order, Fourth-order Runge-Kutta method, Numerical solution of Partial Differential Equations.

**Module 5. Numerical solution of Partial Differential Equations(PDE)** – General linear Partial Differential Equations, Classifications (Elliptic, Parabolic, Hyperbolic PDE), Solution of Laplace, Poisson, Heat and Wave Equations by Different Methods.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Understand the bases of linear programming, unconstrained optimization, and constrained optimization.

**CO 2:** Able to analyze the behavior of these numerical methods and in particular to discuss their stability, order of convergence and conditions of application.

**CO 3:** Demonstrate the abilities to apply knowledge of mathematics and computing to the design and analysis of optimization methods.

**CO 4:** Analyze a problem and identify the computing requirements appropriate for its solution.

**List of Text Books**


1. S.S. Sastry, Numerical Analysis, Prentice-Hall India (module I), 4th Edition,2012.
2. G. Dahlquist, Å. Björck, Numerical Methods, Courier CorporationPublication, 2003.
3. D. Bertsimas, J. N. Tsitsiklis, Introduction to Linear Optimization. Athena Scientific, Belmont, MA, ISBN 1886529191,1997.
4. M. S. Bazaraa, J. J. Jarvis, H. D. Sherali, Linear Programming and Network Flows, John Wiley & Sons, 4th edition, ISBN 978-0-470-46272-0, 2010.


**List of Reference Books**


1. S.S Rao, Optimization Theory and Applications, Wiley Eastern,5th Edition, 2019.
2. C. F. Gerald, P.O.Wheatley, Applied Numerical Analysis, Pearson Education Asia, Seventh Edition, 2004.
3. K. Swarup, P. K. Gupta, Man Mohan, Operations research, Sultan Chand & Sons.(module II), 5th Edition,2010.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | Second |
| **Course Name** | Object Oriented Programming |
| **Course Code** | MCA-2003 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

Fundamentals of Computer Programming using C (MCA-2001)

**Course Learning Objectives**

1. To learn about the data and its various instructions.
2. To learn about the parameters to decide access level modifiers to achieve appropriate level of encapsulation.
3. To learn the designing and implementation of programs where two or more classes interact.

**Course Content**

**Module 1:Introduction to Object-Oriented Programming:** Overview and properties of OOPs, Object-oriented vs. Procedural programming, Pillars of OOPs: Encapsulation, Abstraction, Inheritance, and Polymorphism, Data Types, Variables, Arrays, Operators, Control Statements, Programming Structures

**Module 2:OOPS Concepts:** Classes and Objects, Creating classes and objects, Accessing members of class, Accessing object properties and methods, Constructors and destructors, Default Constructor, Parameterized Constructor, Copy Constructor, The Default Copy Constructor, Objects as Function Arguments, Returning Objects from Functions, Structures and Classes, Memory allocation for Objects, Static members, Member functions defined outside the class.

**Module 3:Inheritance:** Inheriting from a class, Overriding methods, Fundamental of operator overloading, Restriction on operator overloading, Abstract classes, Polymorphism, Dynamic binding, Virtual functions, Overloading unary and binary operator, Data Conversion.

**Module 4: C++ Program**: Features, Comments, Output Operators, I/O stream File, Namespace, C++ Statements, Variable, Input Operator, Cascading I/O Operator, Example with Class, Structure of C++, Creating Source File, Compiling and Linking.

| **Course Outcomes** |
|---|
| At the end of this course the students will be able to:<br><br>**CO 1** : To understand how to use functions and pointers in C++ programs.<br>**CO 2** : Understand the use of tokens, expressions, and control structures.<br>**CO 3** : Understand the use arrays and strings and create programs using them. |
| **List of Text Books** |
| 1. Paul Deitel, Harvey Deitel **,***C++20* for programmers: An Objects-Natural Approach, 3rd Edition , 2020.<br>2. Gerardus Blokdyk, Object Oriented Programming, 2nd edition, 2018. |
| **List of Reference Books** |
| 1. Stanley Lippman, Josée Lajoie , Barbara Moo, *C++ Primer*, 5th Edition, 2012.<br>2. Robert Lafore, Object Oriented Programming in *C++*, 4th edition, 2001. |

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | Second |
| **Course Name** | Microprocessors |
| **Course Code** | MCA-2004 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

Computer Organization and Architecture (MCA-1003)

**Course Learning Objectives**

1. To describe the architecture of the 8085 and 8086 microprocessor, including registers, memory, ALU, and control unit.
2. To develop proficiency in writing assembly language programs of 8085 and 8086 microprocessors.
3. To understand the role of interrupts in handling events and real-time requirements.

**Course Content**

**Module 1**. **Introduction & Architecture of 8085:** Introduction to Microprocessor, its historical background and Microprocessor applications. INTEL 8085: Microprocessor Architecture and its operations, 8085 MPU and its architecture, 8085 instruction cycle and timing diagram, Memory read and Memory Write operations, Instructions for 8085: Data movement, Arithmetic and logic; and branch control instructions., RISC v/s CISC processors.

**Module 2**. **Introduction & Architecture of 8086:** INTEL 8086: Introduction, 8086 Architecture, real and Protected mode, Memory Addressing, Memory Paging, Addressing Modes. Pin diagram of 8086.

**Module 3. Introduction of various types of Instruction Set:** Various types of instructions: Data movement, Arithmetic and logic; and program control.

**Module 4**. **Interrupts and Controller:** Introduction, 8259 Interrupt controller, Basic DMA operation and 8237 DMA Controller.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Analyze and evaluate the architecture and operation of the 8085 microprocessor to create solutions for complex programming and interfacing challenges.

**CO 2:** Synthesize and create efficient assembly language programs and interfaces for the 8086 microprocessor.

| |
|---|
| **CO 3:** Analyze various types of instruction sets, showcasing their knowledge and comprehension of microprocessor architecture.<br>**CO 4:** Create effective interrupt-driven systems and controller configurations, demonstrating advanced cognitive and practical skills. |
| **List of Text Books** |
| 1. S.Ramesh Goankar, 8085 Microprocessor, 6th Edition, Prentice Hall, 2013.<br>2. Liu, Gibson, Microcomputer Systems: 8086/8088 family: Architecture, Programming and Design, PHI, 1997. |
| **List of Reference Books** |
| 1. B. B. Brey, The intel microprocessors, Pearson Prentice Hall, 2011.<br>2. B.Ram, Fundamentals of Microprocessor and Microcomputers. India: Dhanpat Rai Publications, 2005. |

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | Second |
| **Course Name** | Software Engineering |
| **Course Code** | MCA -2005 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To discuss the evolution, impact and emergence of the software engineering discipline.
2. To use different software life cycle models for real life industrial applications.
3. To discuss different aspects of software project management, risk management and configuration management
4. To explain various requirement elicitation, analysis and specification techniques.

**Course Content**

**Module 1: Introduction to Software Engineering:** The Evolving Role of Software, Software Engineering importance, emergence, Phases of software development, Feasibility study, and Requirement Analysis, Design, Implementation, Testing, and Maintenance phases. Software Myths. A generic view of Process: Software Engineering-A Layered Technology, A process framework,

**Module 2: Software Life Cycle Models:** Models: The Incremental model, The RAD model, Evolutionary Process models: prototyping, Spiral, The Concurrent Development model, and Agile model, Compare Life cycle models. An Agile view of Process: What is Agility, Agile Process models: XP, ASD, DSDM, Scrum, Crystal, FDD, AM.

**Module 4: UML:** Conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, Requirement Capture with Use case building blocks of Use Case diagram - actors, use case guidelines for use case models, component diagrams. Activity diagram: Elements of Activity Diagram - Action state, Activity state, Object. Node, Control and Object flow, Transition (Fork, Merge, Join).

**Module 3: Requirements Analysis and Design:** Requirement Analysis, Analysis process, Requirements specification, desirable characteristics of an SRS, structure of an SRS document, Data Flow Diagrams - Role of Software Architecture and Architecture. Views - Planning for a

Software Project, Software Design, Software design concepts, Function Oriented Design and its Complexity Metrics, Object Oriented Design and its Complexity Metrics, Detailed Design.

**Module 4: Software Implementation and Testing:** Software Coding, Programming Principles and Coding Guidelines, Method of Incrementally Developing Code, Managing the Evolving Code. Testing, Unit Testing and Code Inspection, Testing Concepts and Testing Process, Design of Test Case and Test Plan, Black-Box Testing, White Box Testing.

**Module 5: Software Project Management:** Software Project Management Framework - methods to estimate project time and cost, Resource Management, Identification, Analysis, mitigation, and monitoring of Project Risks - Ensuring Project quality and quality management, Configuration Management, Change management, CMMI, different levels and need of accreditation.

**Course Outcomes**

On successful completion of the course, students should be able to:

CO 1: Choose a proper life cycle model for different real life industrial applications, design software using function-oriented approach (DFDs) and object-oriented approach (UML diagrams).

CO 2: Understand the concepts of computer aided software engineering (CASE) and use different CASE tools in the development, maintenance and reuse of software systems.

CO 3: Know the emerging concepts like cloud computing, middleware, SOA etc., their functioning and their applications in real life problems.

**List of Text Books**


1. Pressman, Roger S., Maxim, Bruce R.. Software Engineering: A Practitioner's Approach. United Kingdom: McGraw-Hill Education, 2020.
2. R. Mall, Fundamentals of Software Engineering, Prentice Hall of India, 2018..


**List of Reference Books**


1. Sommerville, Ian. Software Engineering, 9/e. India: Dorling Kindersley, 2011..
2. Jalote, Pankaj. An Integrated Approach to Software Engineering. Germany: Springer New York, 2013.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | First |
| **Semester** | Second |
| **Course Name** | Computational Techniques Lab |
| **Course Code** | MCA-2006 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To identify and explain the basic syntax and structure of HTML, CSS, JavaScript, and MySQL.
2. To combine front-end and back-end components to create a seamless user experience.
3. To develop static web pages and create interactive and responsive user interfaces using JavaScript and CSS.
4. To Compare and contrast different methods for handling data storage and retrieval.

**Course Content**

**Module 1: Web Basics:** Protocol, Internet, TCP/IP Protocol, DNS, HTTP, Client Server Technology, Working of Website, List of Web servers, Types of Languages, Compiler vs Interpreter, Meaning of Full Stack Developer, Skills Required for Website Development, List of Famous Software's for Web Development.

**Module 2: Front End Web Development:** HTML: Introduction to HTML5, Tag, Element and Attribute, Creating Tables, Embedding Contents, Working with Forms, Meta Tags, iFrames, List of all HTML Tags in Single Page. CSS: Introduction to CSS3, Inline CSS, CSS Comments, Internal CSS, External CSS, Linking CSS, How to Debug CSS Code, CSS Box, CSS Floating Columns, Positioning Elements.

**Module 3: JAVASCRIPT:** Introduction to JavaScript, JavaScript Terminology, How to Debug JavaScript Code, JavaScript Language Syntax, Projects with JavaScript. BOOTSTRAP: Overview of Bootstrap, how to use Bootstrap, Project 1: Starter Website with Bootstrap, Project 2: Personal Portfolio Page.

**Module 4: Back End Web Development:** PHP: Setting up the PHP Environment, PHP Language Basics, Variable and Constants, Expressions and Operators, Data Types,

Namespaces, Control Structures, Strings, Arrays, Functions, Handling Exceptions, Files, Date and Time.

**Module 5: MYSQL, WORDPRESS, PHP OOP:** Introduction to xml, Complete understanding of JSON, Introduction to rest and API and PROJECTS: Complete Website with PHP, Complete Website with WordPress.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Demonstrate proficiency in creating and designing web pages using HTML, CSS, and JavaScript.
**CO 2:** Build interactive and dynamic web applications that communicate with a back-end server.
**CO 3:** Exhibit competence in utilizing MySQL to manage and manipulate data within a database.
**CO 4:** Integrate front-end and back-end components to develop full-stack web applications.
**CO 5:** Design and develop a comprehensive web project showcasing their skills in full-stack web development.

**List of Text Books**


1. J. Niederst Robbins, Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, 5th Edition. O'Reilly Media, 2018.
2. J. Duckett, HTML and CSS: Design and Build Websites. Wiley, 2011.
3. M. Haverbeke, Eloquent JavaScript: A Modern Introduction to Programming, 3rd Edition. No Starch Press, 2018.


**List of Reference Books**


1. N. C. Zakas, Professional JavaScript for Web Developers, 4th Edition. Wrox, 2019.
2. P. DuBois, MySQL Cookbook: Solutions for Database Developers and Administrators, 3rd Edition. O'Reilly Media, 2014.
3. E. Freeman and Elisabeth Robson, Head First HTML and CSS: A Learner's Guide to Creating Standards-Based Web Pages, 2nd Edition. O'Reilly Media, 2012.

# 3rd Semester

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Database Management System |
| **Course Code** | MCA-3001 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand fundamentals of data models and to conceptualize a database system for user requirements.
2. To study the fundamentals of database query language, like SQL, relational algebra, and concept of normalization in database design.
3. To learn fundamental concepts of transaction processing, concurrency control techniques and database recovery procedure.
4. To understand the professional, ethical and security issues and responsibilities in database design.

**Course Content**

**Module 1. Introduction:** DBMS Historical Perspective, File Versus a DBMS, Advantages of DBMS, Architecture of DBMS, Data Independence, Database Languages & Interfaces, DDL, DML, DCL, Database Administrator, Database Users, Different Data Models, Comparison of Various Database Models, Protection, Security.

**Module 2. Entity Relationship Model:** Data Modeling using ER Model, Features of ER model, Entities, Attributes and Relationships, Constraints, Entity Sets, Attributes Sets, Conceptual Design using ER model, Design for Large Enterprises, Extended ER Model, and Translating ER Model into Tables.

**Module 3. Relational Data Model and Query Language:** RDBMS Concepts, Characteristics, Schema, Constraints, Relational Algebra, Relational Calculus, Domain and Tuple Calculus, A Relational Database Language, SQL, Creation and Basic Query Structure, Basic Operations, Aggregate, Grouping, Having Clause, Exist, Set, Join, Division Operation, SQL Completeness, Nested Subqueries, Query Optimization, Views and Triggers.

**Module 4. Relational Database Design:** Database Design Concept, Functional Dependencies, Dependency Preserving, Decomposition, Lossless Join, Problems with Null Valued, Dangling Tuples, Normalization for Relational Databases, Database Normalization: 1NF, 2NF, 3NF, BCNF, Multivalued Dependency, 4NF, Join Dependency, 5NF.

**Module 5. Concurrent Operations on Databases:** Concepts of Transaction Processing, Schedule, Transaction Failure, Recovery, Concurrency Control, Locking Based Protocols.

**Module 6. File Organizations and Indexing:** File Organizations Techniques, Primary Secondary Index Structures, Various Index Structures, Hash-based Indexing, Dynamic Hashing Techniques, Multi-level Indexes, and B+ Trees.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Demonstrate various database models and tools.

**CO 2:** Compare and contrast logical design methods of DBMS.

**CO 3:** Develop sophisticated queries to extract information from large datasets.

**CO 4:** Understand and evaluate the role of database management systems in software.

**List of Text Books**


1. A.Silberschatz, H. F.Korth, S. Sudarshan, Database System Concepts. United Kingdom: McGraw-Hill Education, 2011.
2. R.Elmasri, S.Navathe, Fundamentals of Database Systems. United Kingdom: Pearson. 2016.


**List of Reference Books**


1. Feuerstein, S., Pribyl, B., Oracle PL/SQL Programming. Germany: O'Reilly, 2002.
2. McFadden, F. R., Hoffer, J. A., Prescott, M. B., Modern Database Management. Singapore: Addison-Wesley, 1998.
3. Bayross I., SQL, PL/SQL The Programming Language of Oracle, BPB Publications (2009) 4th ed.
4. Hoffer J., Venkataraman, R. and Topi, H., Modern Database Management, Pearson (2016) 12th ed.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Data Analytics |
| **Course Code** | MCA-3002 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To learn about identifying the meaningful content present in a given data set and various techniques to explore, organize and visualize it.
2. To learn about the pre-processing of data. What is data, how it is collected, the role of metadata and how to assess the quality/reliability of data.
3. To learn about the use of beginning level proficiency tools of statistics and machine learning to ask questions and explore patterns in data.

**Course Content**

**Module 1: Introduction** to data science, exploratory data analysis, Introduction to machine learning, Linear regression and regularization, Model selection and evaluation, Classification: KNN, decision trees. Types of Big Data, Design goals of Big Data platforms, and where in the systems landscape these platforms fall.

**Module 2: Classification:** SVM, Ensemble methods: random forests, Introduction to probability Models, Naive Bayes, logistic regression, Feature engineering and selection, K-means Clustering, Hierarchical clustering. Distributed programming models for Big Data, including Map Reduce, Stream processing and Graph processing.

**Module 3: Dimensionality Reduction:** PCA and SVD, Text mining and information retrieval, Network analysis, Recommender systems, Relational databases, SQL, Big data storage and retrieval, Graph DB.

**Module 4: Big Data Distributed Computing:** Map reduce, Spark RDD, Hive, Hbase, Pig, Advanced neural networks and deep learning.

**Module 5: Design and Development:** Designing of Big Data platforms and their optimizations on commodity clusters and Clouds, Scaling data Science algorithms and analytics using Big Data platforms.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1** : Understand statistical analysis of data and the use of computation tools for data analysis.
**CO 2** : Learn to apply the statistical and computational tools to applied problems, and clearly communicate the results in both written reports and oral presentations.
**CO 3** : Understand the importance of proper data management, documentation of work to allow reproducibility of results.

**List of Text Books**


1. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics, MIT Press,2nd Edition 2020.
2. G. James, D. Witten, T. Hastie, R. Tibshirani, An introduction to statistical learning with applications, Springer, 2013.
3. J. Han, M. Kamber, J. Pei, Data mining concepts and techniques. Morgan Kaufmann, 2011.


**List of Reference Books**


1. Bogumil Bogumil,Julia for Data Analysis,Simon and Schuster, 2023
2. T. Hastie, R. Tibshirani, J. Friedman, The elements of statistical learning 2nd edition Springer, 2008.
3. Kevin P. Murphy, Machine learning: A probabilistic perspective, MIT Press,2012.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Formal Languages and Automata Theory |
| **Course Code** | MCA-3003 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand formal languages, grammars and computation theory.
2. To demonstrate the concepts of automata theory and turing machines.
3. To compare and contrast solvable and unsolvable problems.

**Course Content**

**Module 1. Introduction to Theory of Computation**: Overview of Formal Languages, Alphabets, Automata and Their Significance, Historical Development and Key Contributors in the field**.**

**Module 2. Finite Automata and Regular Languages**: Definitions and types of Finite State Machine, Transition Graphs, Regular Grammar, Convert Regular Expression to NDFA, Convert NDFA to DFA, Minimization of DFA, Moore machine and Mealy Machine, Conversion of Moore Machine to Mealy Machine & Vice-Versa, Conversion of DFA to Regular Expression, Pumping Lemma, Properties and Limitations of Finite State Machine, Application of Finite Automata.

**Module 3. Context-Free Grammars and Pushdown Automata:** Derivation Tree and Ambiguity, Unambiguous CFG for algebraic expressions, Chomsky and Greibach Normal form, Properties of Context Free Grammar, Application of Context Free Grammars, CKY Algorithm, Decidable Properties of Context Free Grammar, Pumping Lemma for Context free Grammar, Pushdown Automata, Design of Deterministic and Non-Deterministic Push-Down Automata, PDA to CFG and Vice Versa.

**Module 4. Turing Machines and Computability:** Definitions of Turing Machines, Computable Languages and Functions, Techniques for Turing Machine Construction, Multi

Head and Multi Tape Turing Machines, The Halting Problem, Partial Solvability, Problems in Turing Machines, Chomsky Hierarchy of Languages.

**Module 5. Unsolvable Problems:** Computable Functions, Recursive and Recursively Enumerable Languages, Universal Turing Machine, Measuring and Classifying Complexity, Tractable and Intractable Problems, Tractable and Possibly Intractable Problems, P and NP Completeness, Polynomial Time Reductions, NP-Complete Problems from Other Domains, Graphs, Clique, Vertex Cover, Independent Sets, Hamiltonian Cycle, Number Problem, Set Cover, Cook's Theorem.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Understand the basic models of computation, such as finite automata, pushdown automata, and Turing machines.

**CO 2:** Use regular expressions to describe patterns and recognize regular languages.

**CO 3:** Identify undecidable problems and use techniques such as diagonalization to prove un-decidability.

**List of Text Books**


1. J. E. Hopcroft, Introduction to Automata Theory, Languages, and Computation. India: Pearson Education, 2008.
2. J. C. Martin, Introduction to Languages and the Theory of Computation. Colombia: McGraw-Hill, 2003.
3. K. L. P Mishra, N.Chandrasekaran, Theory of Computer Science: Automata, Languages and Computation. India: PHI Learning, 2007.


**List of Reference Books**


1. Harry R Lewis and Christos H Papadimitriou, Elements of the Theory of Computation, Prentice Hall of India, Pearson Education, New Delhi, 2003.
2. Krithivasan, K., Introduction to Formal Languages, Automata Theory and Computation. India: Pearson Education, 2009.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Digital Image Processing |
| **Course Code** | MCA-3004 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the fundamental concepts of image processing with various components and steps involved.
2. To understand and implement the various image enhancement and filtering techniques using MATLAB programming.
3. To understand and analyze various image processing techniques in real life applications.

**Course Content**

**Module 1. Introduction to Image Processing Systems:** Origin and examples, Basic image processing steps and components, Elements of visual perception, Image sensing and acquisition, Sampling and quantization, Relationship between pixels, Image operations like arithmetic, logical, and geometrical operation.

**Module 2. Image Enhancement in Spatial Domain:** Basic intensity transformation functions, Point processing, Neighborhood processing, Histogram equalization and specification, Spatial filtering, Smoothing filtering, Sharpening filtering.

**Module 3. Image Enhancement in Frequency Domain:** Image Transforms, Low pass frequency domain filter, High pass frequency domain filters, Homomorphic filtering, Fourier Transform with its limitations, Wavelets with its properties, Discrete Wavelet Transform, Advanced Wavelet Transforms.

**Module 4. Image Segmentation:** Detection of discontinuation by point detection, line detection, edge detection, Edge linking and boundary detection, Local analysis, global by graph, Theoretic techniques, Thresh-holding.

**Module 5. Miscellaneous:** Morphological image processing, Basic morphological algorithms, dilation, erosion. Image restoration. Image degradation models. Image Compression. Color image processing.

| **Course Outcomes** |
|---|
| At the end of this course the students will be able to:<br>**CO 1:** To perform and apply digital image processing in real-life applications.<br>**CO 2:** Understand various image processing techniques in spatial and frequency domain.<br>**CO 3:** Understand and apply image processing techniques to solve various real time problems. |
| **List of Text Books** |
| 1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, 4th edition, Pearson Education, New York, 2018.<br>2. Tian-Xiao He, Wavelet Analysis and Multiresolution Methods (Lecture Notes in Pure and Applied Mathematics Book 212), CRC Press; 1st edition, 2021.<br>3. Anil K. Jain, Fundamentals of Digital Image Processing,1st edition, Pearson India, 2015. |
| **List of Reference Books** |
| 1. Sabrine Arfaoui, Anouar Ben Mabrouk, Carlo Cattani, Wavelet Analysis Basic Concepts and Applications, CRC Press, 2021.<br>2. R.J. Schalkoff, Digital Image Processing and Computer Vision, John Wiley and Sons, NY, 1989.<br>3. William K. Pratt, Digital Image Processing, John Wiley and Sons, NY, 2007. |

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Project Design |
| **Course Code** | MCA-3005 |
| **Compulsory /Elective** | Compulsory |
| **Prerequisites** | |
| NA | |
| **Course Description** | |

This course is part of a large project divided into three parts namely project design in third semester, project implementation in fourth semester and project dissertation in fifth semester.

**Course Objective:** Students are given the responsibility of conducting a survey or actively engaging with society to identify real-life problems. They are expected to propose logical and well-thought-out steps while utilizing appropriate technologies to address these identified problems effectively. Afterward, the students are required to design system components or processes that aim to provide viable solutions to the real-life problems. The primary focus of this task involves problem identification and validation, the formulation and evaluation of needs, generation and assessment of potential solutions, and the final selection of the most appropriate ones. Furthermore, students will engage in the development and evaluation of prototypes as part of the comprehensive process.

**Project Group and Supervisor:** A project group refers to a collaborative effort where students, under the guidance of a faculty member, work together on a specific problem, subtask of a larger problem, or a problem set. In such instances, it is essential to establish clear deliverables for each student within the group.

**Duration**: The project design requires a minimum duration of approximately 12 to 16 weeks, with an expected completion by the final week of the semester in the relevant academic year.

**The project work allows for three possible approaches:**

1. Pursuing novel and innovative ideas.

2. Extending previous research efforts.

3. Tackling abstract or proof-of-concept problems.

**Deliverables**: The expected deliverables will consist of one or more of the following:

1. Software/hardware-based product addressing a real-world problem.

2. Embedded systems (software-hardware combined).

3. Research work presented in the form of conference/journal papers.

4. Comparative studies of products, methods, or designs.

5. Results from system design and simulation studies.

6. Theoretical modeling and technical studies.

In cases where certain projects do not neatly fit into the mentioned categories, the respective supervisor will identify specific deliverables for those projects. This process will require a comprehensive report and approval from higher authorities.

**Expectations from the student:** During the project tenure, students are expected to adhere to the following guidelines:

1. Completing the assigned project work provided by the supervisor and meeting all identified milestones promptly.
2. Following the work-plan established by their respective supervisor, which includes adhering to reporting procedures and complying with designated working hours throughout the project duration.
3. Submitting the project report in the prescribed format to the project coordinator only after obtaining approval from the supervisor, well before the due date.
4. Taking full responsibility for avoiding plagiarism and respecting copyright issues.

**Project Outcomes:**

The outcome of the project should be in the form of as followings:

1. Research Paper/Patent/Copyright.

2. Any winning position in hackathon/national or international competitions.

**Report**: The mid-semester report must strictly adhere to specific guidelines, limiting its length to 10 pages in a single-column format, using 12-point Times New Roman font. It is essential to submit the report before the mid-semester examination of the academic year. As for the final report, it should be a comprehensive summary of the student's work, meeting the minimum length requirement of 40 pages in a single-column format, with a font size of 12 points and Times New Roman. The minimum page limit of 40 pages will be strictly enforced, and students should ensure that their report encompasses all relevant aspects of their work. To maintain academic integrity, all reports will undergo a plagiarism check using Turnitin or a similar anti-plagiarism software. Any reports with a similarity of more than 5% to a single source and a cumulative similarity of over 20% will not be accepted and will not be forwarded to the evaluation committee supervisor/mentor. It is important to note that once submitted, subsequent revisions of the report will not be allowed under any circumstances. Therefore, students must exercise caution and precision when preparing their reports to meet the specified requirements.

**General Instructions:**

1. Students need to form a group of 3 to 5 students, and consult with the faculties (based on area of expertise) to work on a project. The same group will be continued for project design, project implementation and project dissertation. Any changes in group or supervisor(s) at any stage need proper justification and approval from higher authorities.

2. Students need to submit the project group details to the project coordinator by 2nd week of starting the semester. Project group details include project title, abstract, details group member, name of supervisor(s) and approval sign of concern supervisor(s).

3. Evaluation will be carried out as following:

| Continuous Evaluation (last week of each month) | | | | End Term Evaluation (at the time of end term exam) | | | Total Marks |
|---|---|---|---|---|---|---|---|
| E1 | E2 | E3 | E4 | Report | Viva-Voce Presentation | Outcomes | |
| 10 | 10 | 10 | 10 | 20 | 20 | 20 | 100 |

4. Students must report the progress of the project work to the respective supervisor(s) at least twice in week as given schedule in the class time table.
5. Continuous Evaluation (E1/E2/E3/E4) will be carried out by the respective supervisor(s) and marks will be submitted to the project coordinator by the end of every month.
6. End Term Evaluation will be carried out by both respective supervisor(s) and project coordinator.

**Course Outcomes**

Upon completion of this course, the students will be able to :

**CO 1:** Improve their knowledge and skills relevant to their areas of specialization.
**CO 2:** Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.
**CO 3:** Acquire knowledge and skills to compete in the job market with this experience and exposure.

# 4th Semester

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Artificial Intelligence and Machine Learning |
| **Course Code** | MCA-4001 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the importance, principles of Artificial Intelligence and machine learning models.
2. Identify the capabilities, strengths and limitations of various AI and machine learning techniques.
3. To give a brief overview of deep learning based models.

**Course Content**

**Module 1: Introduction and Basics of AI and Machine Learning:** Overview of AI: its history, and its impact on society, AI vs. Human Intelligence, AI subfields (e.g., robotics, natural language processing), and ethics in AI, Machine Learning Fundamentals, Introduction to machine learning, supervised vs. unsupervised learning, and the machine learning pipeline.

**Module 2: Foundations of Data Preprocessing, Regression, and Model Evaluation:** Foundations of Data Preprocessing, Regression, and Model Evaluation, Data preprocessing, feature engineering, and model evaluation, Linear Regression and Classification, Linear regression, cost functions, and gradient descent, Logistic regression, binary and multi-class classification, and evaluation metrics.

**Module 3: Supervised and Unsupervised Learning:** Decision trees, random forests, and ensemble methods, Support vector machines (SVM), k-nearest neighbors (KNN), and overfitting, Clustering algorithms (k-means, hierarchical), and dimensionality reduction (PCA), Association rule mining, frequent item sets, and outlier detection.

**Module 4: Introduction to Neural Networks:** The basics of neural networks, activation functions, and forward propagation, Backpropagation, gradient descent for neural networks, and deep learning frameworks.

**Module 5: Deep Learning, Practical Applications, and Future Trends:** Convolutional neural networks (CNNs) for image analysis, Recurrent neural networks (RNNs) for sequential data and long short-term memory (LSTM), Practical applications of AI and ML in industries such as healthcare, finance, and autonomous vehicles, Current and future trends in AI.

**Course Outcomes**

At the end of the course students will be able to:

**CO 1:** Represent a problem using first order and predicate logic.

**CO 2:** To design, create and implement intelligent software applications to solve real-world business and industrial problems.

**CO 3:** Evaluate available learning methods on real world problems.

**CO 4:** Apply selected machine learning models.

**List of Text Books**


1. S. Russell, P. Norvig,Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2021.


**List of Reference Books**


1. E. Rich, K. Knight, Shivashankar B Nair, Artificial Intelligence, McGraw Hill, 3rd ed.,2017.
2. D. Patterson, Introduction to artificial intelligence and expert systems. Prentice-Hall, Inc., 2015.
3. S. Kaushik, Logic and prolog programming, New Age International, 2007.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Computer Networks |
| **Course Code** | MCA-4002 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To explore the functions and responsibilities of each OSI layer in network communication.
2. To establish connections between devices to facilitate seamless data transmission and effective communication.
3. To acquire knowledge about key concepts such as Flow Control, Error Detection & Correction, and Transmission Media.
4. To understand the fundamental principles governing routing and addressing in networking.

**Course Content**

**Module 1: Physical Layer:** Network hardware, Network software, OSI, TCP/IP Reference models, Example Networks: ARPANET, Internet. Guided Transmission media: Twisted pairs, Coaxial cable, Fiber optics, Wireless transmission.

**Module 2:Data-Link Layer**: Design Issues, Framing, Error Detection and Correction, FEC Vs Retransmission, Encoding and Decoding Techniques, Error Detection and Correction, Elementary data link protocols: Noisy and Noiseless Channels, Medium Access sublayer: Channel Allocation Problem, Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Collision Free Protocols. Wireless LANs, Data Link Layer Switching.

**Module 3: Network Layer:** Design Issues, IP Addressing: Subnetting and Supernetting, Routing Algorithms: Shortest Path Routing, Flooding, Hierarchical Routing, Broadcast, Multicast, Distance Vector Routing, Congestion Control Algorithms, Quality of Service, Internetworking.

**Module 4: Transport Layer:** Transport Services, Elements of Transport Protocols, Connection Management, TCP and UDP Protocols. Multiplexing, Flow Control and Retransmission, Window Management, TCP Congestion Control, Quality of service.

**Module 5: Application Layer**: Domain Name System, SNMP, Electronic Mail; the World Wide Web, HTTP, Streaming Audio and Video. File Transfer Protocol, Remote Login, Network Management, Data Compression, Cryptography: Fundamentals.

**Course Outcomes**

At the end of the course students will be able to:

**CO 1:** Recognize the essential concepts, the OSI reference model, the TCP/IP protocol, services, networks, transmission mediums, and analogue and digital data transfer.

**CO 2:** To be able to work with network layer's features, such as the routing algorithm, logical addressing, and subnetting.

**CO 3:** Analyze Explain the functions offered by session and presentation layer and their Implementation.

**CO 4:** Apply channel allocation, framing, error and flow control techniques

**CO 5:** Simulate the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.

**List of Text Books**


1. A. S. Tanenbaum, N. Feamster, D. J. Wetherall, Computer Networks, 6th edition, Pearson Education, April 2021.
2. Forouzan, Behrouz A.., Fegan, Sophia Chung. Data Communications and Networking (McGraw-Hill Forouzan Networking). United Kingdom: McGraw-Hill Higher Education, 2017.


**List of Reference Books**


1. James, Kurose, K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 7th Edition, Pearson Education, 2017.
2. W.A. Shay, Understanding communications and Networks, 3rd Edition, B.S. PUBLICATIONS, 2008.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Data Warehousing and Data Mining |
| **Course Code** | MCA- 4003 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

Database Management System (MCA-3001)

**Course Learning Objectives**

1. To uncover valuable knowledge and insights from large datasets through data mining techniques.
2. To facilitate Decision-Making: Support effective decision-making by providing timely and relevant information stored in data warehouses.
3. To enhance Predictive Analysis: Develop models for predicting future trends and behaviors based on historical data stored in data warehouses.
4. To optimize Query Performance: Improve the efficiency of data retrieval and analysis through well-designed data warehousing structures.

**Course Content**

**Module 1. Introduction:** Data Mining Concepts, Input, Instances, Attributes and Output, Knowledge Representation. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity. Data Preparation: Data Cleaning, Data Integration & Transformation, Data Reduction. Data Discretization and Concept hierarchy generation.

**Module 2.Mining Association Rules:** Associations, Maximal Frequent & Closed Frequent item sets, Covering Algorithms & Association Rules, Linear Models & Instance-Based Learning, Mining Association Rules from Transactional databases, Mining Association Rules from Relational databases & Warehouses, Correlation analysis & Constraint based Association Mining.

**Module 3.Classification and Prediction:** Basic Concepts, Supervised Learning Framework, concepts & hypothesis, Training & Learning. Issues regarding Classification & Prediction, Classification by Decision Tree induction, Bayesian classification, Classification by Back Propagation, k-Nearest Neighbor Classifiers, Genetic algorithms, Rough Set & Fuzzy Set approaches.

**Module 4. Cluster Analysis:** Types of data in Clustering Analysis, Categorization of Major Clustering methods, Hierarchical methods, Density-based methods, Grid-based methods, Model-based Clustering methods.

**Module 5. Data Warehouse Basic Concepts:** Data Cube and OLAP, Typical OLAP Operations, Data Warehouse Design and Usage: OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. Warehousing applications and Recent Trends: Types of Warehousing Applications, Web Mining, Spatial Mining and Temporal Mining.

**Course Outcomes**

After completion of the course students will be able to:

**CO 1:** Extract meaningful patterns and knowledge from large datasets for informed decision-making.
**CO 2:** Identify hidden relationships and trends within data to support business intelligence.
**CO 3:** Enhance predictive modeling by discovering valuable insights and patterns in historical data.
**CO 4:** Improve marketing strategies by analyzing customer behavior and preferences through data mining.

**List of Text Books**


1. Han, Jiawei., Pei, Jian., Tong, Hanghang. Data Mining: Concepts and Techniques. Netherlands: Elsevier Science, 2022.
2. A.Berson, S. J. Smith. Data warehousing, data mining, and OLAP. McGraw-Hill, Inc, 638 Pages, ISBN: 978-0070587410, 2017.


**List of Reference Books**


1. M. Humphries, Data warehousing: architecture and implementation. Pearson Education India, 384 pages, ISBN: 0130809020, 978-0130809025, 1999.
2. I. H. Witten, E. Frank, Data Mining: Practical Machine Learning Tools and Techniques with Java implementations, Morgan Kaufmann Publishers, San Fransisco, CA. 371 pages, ISBN: 1558605525, 978-1558605527, 2000.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Project Implementation |
| **Course Code** | MCA-4004 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Description**

This course is part of a large project divided into three parts namely project design in third semester, project implementation in fourth semester and project dissertation in fifth semester.

**Course Objective:** Students are expected to take the designs and prototypes they developed during the project design subject in the previous semester and translate them into practical product implementations with real-life applications in society or industry. This demonstrates their ability to convert the developed prototypes or working models into viable solutions that have a positive impact on society or industry. Throughout the product development phase, students must adhere to applicable codes, regulations, standards, and models, and they are also required to document their progress through clear and concise technical reports or research articles. The assignment places particular emphasis on providing a well-defined problem specification and establishing clear milestones to be achieved in order to effectively address the identified problem.

**Project Group and Supervisor:** A project group refers to a collaborative effort where students, under the guidance of a faculty member, work together on a specific problem, subtask of a larger problem, or a problem set. In such instances, it is essential to establish clear deliverables for each student within the group.

**Duration**: The project Implementation requires a minimum duration of approximately 12 to 16 weeks, with an expected completion by the final week of the semester in the relevant academic year.

**The project work allows for three possible approaches:**

1. Pursuing novel and innovative ideas.

2. Extending previous research efforts.

3. Tackling abstract or proof-of-concept problems.

**Deliverables**: The expected deliverables will consist of one or more of the following:

1. Software/hardware-based product addressing a real-world problem.

2. Embedded systems (software-hardware combined).

3. Research work presented in the form of conference/journal papers.

4. Comparative studies of products, methods, or designs.

5. Results from system design and simulation studies.

6. Theoretical modeling and technical studies.

In cases where certain projects do not neatly fit into the mentioned categories, the respective supervisor will identify specific deliverables for those projects. This process will require a comprehensive report and approval from higher authorities.

**Expectations from the student:** During the project tenure, students are expected to adhere to the following guidelines:

1. Completing the assigned project work provided by the supervisor and meeting all identified milestones promptly.
2. Following the work-plan established by their respective supervisor, which includes adhering to reporting procedures and complying with designated working hours throughout the project duration.
3. Submitting the project report in the prescribed format to the project coordinator only after obtaining approval from the supervisor, well before the due date.
4. Taking full responsibility for avoiding plagiarism and respecting copyright issues.

**Project Outcomes:**

The outcome of the project should be in the form of as followings:

1. Research Paper/Patent/Copyright.

2. Any winning position in hackathon/national or international competitions.

**Report**: The mid-semester report must strictly adhere to specific guidelines, limiting its length to 10 pages in a single-column format, using 12-point Times New Roman font. It is essential to submit the report before the mid-semester examination of the academic year. As for the final report, it should be a comprehensive summary of the student's work, meeting the minimum length requirement of 40 pages in a single-column format, with a font size of 12 points and Times New Roman. The minimum page limit of 40 pages will be strictly enforced, and students should ensure that their report encompasses all relevant aspects of their work. To maintain academic integrity, all reports will undergo a plagiarism check using Turnitin or a similar anti-plagiarism software. Any reports with a similarity of more than 5% to a single source and a cumulative similarity of over 20% will not be accepted and will not be forwarded to the evaluation committee supervisor/mentor. It is important to note that once submitted, subsequent revisions of the report will not be allowed under any circumstances. Therefore, students must exercise caution and precision when preparing their reports to meet the specified requirements.

**General Instructions:**

7. Students need to form a group of 3 to 5 students, and consult with the faculties (based on area of expertise) to work on a project. The same group will be continued for project design, project implementation and project dissertation. Any changes in group or supervisor(s) at any stage need proper justification and approval from higher authorities.

8. Students need to submit the project group details to the project coordinator by 2nd week of starting the semester. Project group details include project title, abstract, details group member, name of supervisor(s) and approval sign of concern supervisor(s).

9. Evaluation will be carried out as following:

| Continuous Evaluation(last week of each month) | | | | End Term Evaluation (at the time of end term exam) | | | Total Marks |
|---|---|---|---|---|---|---|---|
| E1 | E2 | E3 | E4 | Report | Viva-Voce Presentation | Outcomes | |
| 10 | 10 | 10 | 10 | 20 | 20 | 20 | 100 |

10. Students must report the progress of the project work to the respective supervisor(s) at least twice in week as given schedule in the class time table.
11. Continuous Evaluation (E1/E2/E3/E4) will be carried out by the respective supervisor(s) and marks will be submitted to the project coordinator by the end of every month.
12. End Term Evaluation will be carried out by both respective supervisor(s) and project coordinator.

**Course Outcomes**

Upon completion of this course, the students will be able to :

**CO 1:** Improve their knowledge and skills relevant to their areas of specialization.
**CO 2:** Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.
**CO 3:** Acquire knowledge and skills to compete in the job market with this experience and exposure.

# 5th Semester

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third |
| **Semester** | Fifth |
| **Course Name** | Cloud Computing |
| **Course Code** | MCA-5001 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To provide a comprehensive knowledge of Cloud Computing, fundamental issues, technologies, applications, and implementations.
2. To expose the students to the frontier areas of Cloud Computing.
3. To understand the security issues in Cloud Computing.

**Course Content**

**Module 1. Introduction to Centralized and Distributed Computing:** Overview of Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and Cloud Computing- Software environments for distributed systems and clouds.

**Module 2. Introduction to Cloud Computing:** Cloud issues and challenges, Properties, Characteristics, Service models, Deployment models. Cloud resources: Network and API, Virtual and Physical computational resources, Data-storage, Virtualization concepts - Types of Virtualization, Introduction to Various Hypervisors, High Availability (HA), Disaster Recovery (DR) using Virtualization, Moving VMs.

**Module 3. Service Models**: Infrastructure as a Service (IaaS) , Resource Virtualization, Server, Storage, Network Case studies, Platform as a Service (PaaS), Cloud platform & Management, Computation, Storage, Case studies. Software as a Service (SaaS), Web services, Web 2.0, Web OS, Case studies, Anything as a service (XaaS).

**Module 4. Cloud Programming and Software Environments:** Parallel and Distributed Programming paradigms, Programming on Amazon AWS and Microsoft Azure, Programming support of Google App Engine, Emerging Cloud software Environment.

**Module 5. Cloud Access**: authentication, authorization and accounting - Cloud Provenance and meta-data, Cloud Reliability and fault-tolerance, Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.

**Module 6. Use Cases**: Azure features use cases, Google cloud services (GCP) Features Use cases, AWS features use cases.

**Course Outcomes**

At the end of this course, the students will be able to:

**CO 1:** Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing.

**CO 2:** Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

**CO 3:** Solve the security issues for cloud services.

**List of Text Books**


1. R. Puttini, T. Erl, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Pearson, 2013.
2. T. Velte, A. Velte, R. Elsenpeter, Cloud Computing A Practical Approach , McGraw Hill Education, 2017


**List of Reference Books**


1. J. Rhoton, Cloud Computing Explained: Handbook for Enterprise Implementation, 2009.
2. R. L. Krutz, R. Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 1st Edition, Wiley, 2010.
3. K. Hwang, G. C. Fox, J. J. Dongarra, Distributed and Cloud Computing From Parallel Processing to the Internet of Things, Morgan Kaufmann, Elsevier, 2012.
4. J. Broberg, A. M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third |
| **Semester** | Fifth |
| **Course Name** | Deep Learning |
| **Course Code** | MCA-5002 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

Artificial Intelligence and Machine Learning (MCA-4001)

**Course Learning Objectives**

1. To analyze and differentiate deep learning algorithms from that of machine learning algorithms.
2. To create an understanding of the fundamental concepts of deep learning.
3. To enhance student's ability to use the concepts of deep learning in solving real-world problems.

**Course Content**

**Module 1. Introduction to Deep Learning:** Basics of Deep Learning, Performance Measures, Decision Surfaces, Bayesian Learning, Linear Classifiers and Machines, Hinge Loss, Optimization Techniques, Gradient Descent, Batch Optimization.

**Module 2. Basics of Neural Networks:** Introduction to Neural Network, Overview and representation of Neural Network, Activation Function, Perceptrons and their limitations, Multilayer network, Feed-forward Neural Networks, Back Propagation learning, Recurrent Neural Networks, Artificial Neural Networks.

**Module 3. Convolution Neural Networks**: Convolutional Neural Network, Building blocks of CNN, Unsupervised Learning with Deep Network, Parameter Initialization, Regularization to CNN , Optimizer selection , Recent advancement in CNN Architectures, Applications areas of CNNs, Transfer Learning.

**Module 4. Recent Trends in Deep Learning:** AlexNet, VGGNet, GoogLeNet, ResNet, DenseNet, Image Denoising, Classical Supervised Tasks with Deep Learning, Semantic Segmentation, Object Detection.

**Module 5. Enhanced Deep Learning Models:** Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam.

**Course Outcomes**

At the end of the course the student will be able to:

**CO 1.** Explain and differentiate between the basic principles behind neural network and deep learning and compare the modelling aspects of neural network architectures.
**CO 2.** Implement and apply deep learning modules in real-datasets
**CO 3.** Learn the applications of deep learning algorithms and their incorporation in the society to achieve better life quality.
**CO 4.** Understand and critically analyze the research work that applies the concepts of deep learning in every possible domain.

**List of Text Books**


1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2023.
2. Liu, Yuxi (Hayden), and Mehta, Saransh. Hands-On Deep Learning Architectures with Python: Create Deep Neural Networks to Solve Computational Problems Using TensorFlow and Keras. India, Packt Publishing, 2019.


**List of Reference Books**


1. Kelleher, John D, Deep Learning, United Kingdom, MIT Press, 2019.
2. Nikhil Ketkar, Deep Learning with Python: A Hands-on Introduction, Apress, 2017.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third |
| **Semester** | Fifth |
| **Course Name** | Project Dissertation |
| **Course Code** | MCA-5003 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Description**

This course is part of a large project divided into three parts namely project design in third semester, project implementation in fourth semester and project dissertation in fifth semester.

**Course Objective:** Students are expected to take the designs and prototypes they developed during the project design subject in the previous semester and translate them into practical product implementations with real-life applications in society or industry. This demonstrates their ability to convert the developed prototypes or working models into viable solutions that have a positive impact on society or industry. Throughout the product development phase, students must adhere to applicable codes, regulations, standards, and models, and they are also required to document their progress through clear and concise technical reports or research articles. The assignment places particular emphasis on providing a well-defined problem specification and establishing clear milestones to be achieved in order to effectively address the identified problem.

**Project Group and Supervisor:** A project group refers to a collaborative effort where students, under the guidance of a faculty member, work together on a specific problem, subtask of a larger problem, or a problem set. In such instances, it is essential to establish clear deliverables for each student within the group.

**Duration**: The project Implementation requires a minimum duration of approximately 12 to 16 weeks, with an expected completion by the final week of the semester in the relevant academic year.

**The project work allows for three possible approaches:**

1. Pursuing novel and innovative ideas.

2. Extending previous research efforts.

3. Tackling abstract or proof-of-concept problems.

**Deliverables**: The expected deliverables will consist of one or more of the following:

1. Software/hardware-based product addressing a real-world problem.

2. Embedded systems (software-hardware combined).

3. Research work presented in the form of conference/journal papers.

4. Comparative studies of products, methods, or designs.

5. Results from system design and simulation studies.

6. Theoretical modeling and technical studies.

In cases where certain projects do not neatly fit into the mentioned categories, the respective supervisor will identify specific deliverables for those projects. This process will require a comprehensive report and approval from higher authorities.

**Expectations from the student:** During the project tenure, students are expected to adhere to the following guidelines:

5. Completing the assigned project work provided by the supervisor and meeting all identified milestones promptly.
6. Following the work-plan established by their respective supervisor, which includes adhering to reporting procedures and complying with designated working hours throughout the project duration.
7. Submitting the project report in the prescribed format to the project coordinator only after obtaining approval from the supervisor, well before the due date.
8. Taking full responsibility for avoiding plagiarism and respecting copyright issues.

**Project Outcomes:**

The outcome of the project should be in the form of as followings:

1. Research Paper/Patent/Copyright.

2. Any winning position in hackathon/national or international competitions.

**Report**: The mid-semester report must strictly adhere to specific guidelines, limiting its length to 10 pages in a single-column format, using 12-point Times New Roman font. It is essential to submit the report before the mid-semester examination of the academic year. As for the final report, it should be a comprehensive summary of the student's work, meeting the minimum length requirement of 40 pages in a single-column format, with a font size of 12 points and Times New Roman. The minimum page limit of 40 pages will be strictly enforced, and students should ensure that their report encompasses all relevant aspects of their work. To maintain academic integrity, all reports will undergo a plagiarism check using Turnitin or a similar anti-plagiarism software. Any reports with a similarity of more than 5% to a single source and a cumulative similarity of over 20% will not be accepted and will not be forwarded to the evaluation committee supervisor/mentor. It is important to note that once submitted, subsequent revisions of the report will not be allowed under any circumstances. Therefore, students must exercise caution and precision when preparing their reports to meet the specified requirements.

**General Instructions:**

13. Students need to form a group of 3 to 5 students, and consult with the faculties (based on area of expertise) to work on a project. The same group will be continued for project design, project implementation and project dissertation. Any changes in group or supervisor(s) at any stage need proper justification and approval from higher authorities.

14. Students need to submit the project group details to the project coordinator by 2nd week of starting the semester. Project group details include project title, abstract, details group member, name of supervisor(s) and approval sign of concern supervisor(s).

15. Evaluation will be carried out as following:

| Continuous Evaluation(last week of each month) | | | | End Term Evaluation (at the time of end term exam) | | | Total Marks |
|---|---|---|---|---|---|---|---|
| E1 | E2 | E3 | E4 | Report | Viva-Voce Presentation | Outcomes | |
| 10 | 10 | 10 | 10 | 20 | 20 | 20 | 100 |

16. Students must report the progress of the project work to the respective supervisor(s) at least twice in week as given schedule in the class time table.
17. Continuous Evaluation (E1/E2/E3/E4) will be carried out by the respective supervisor(s) and marks will be submitted to the project coordinator by the end of every month.
18. End Term Evaluation will be carried out by both respective supervisor(s) and project coordinator.

**Course Outcomes**

Upon completion of this course, the students will be able to :

**CO 1:** Improve their knowledge and skills relevant to their areas of specialization.
**CO 2:** Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.
**CO 3:** Acquire knowledge and skills to compete in the job market with this experience and exposure.

# 6th Semester

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third |
| **Semester** | Sixth |
| **Course Name** | Industrial Internship / R&D Project |
| **Course Code** | MCA-6001 |
| **Compulsory /Elective** | Compulsory |

**Prerequisites**

NA

**Course Learning Objectives**

1. To give students the opportunity to apply the knowledge and skills they have acquired on campus in a real-life work situation.
2. To provide students with opportunities for practical, hands-on learning from practitioners in the students' areas of specialization.
3. To expose students to a work environment, common practices, employment opportunities and work ethics in their relevant field.
4. To enhance the employability skills of the students.
5. To provide opportunities for students to be offered jobs in the organizations in which they undergo their Industrial Training.

**Course Content**

**Industrial Internship**

As per the regulations, the student should undergo industrial internship for a period of six months after 5$^{th}$ semester. Before proceeding on Industrial Internship, students must seek instructions from the Training & Placement officer or the Faculty coordinator, who is the in-charge of Industrial Training.

The student is responsible to ensure that all matters relating to the Industrial Training Programme are conducted in an ethical, conscientious, trustworthy and committed manner.

**A) Before Industrial Training**

(i)To apply for a suitable Industrial Training, submit an application form (available on website) through the Training and Placement Officer and faculty Coordinator.

(ii)Submit one copy of the offer letter for the Industrial Training with application form to the Faculty coordinator Industrial Training). Students are not allowed to change their Industrial Training after obtaining the approval and confirmation from the Industry.

(iii) To complete the Industrial Training placement process within the specified time based on the Industrial Training Programme schedule.

(iv) To ensure that the Industrial Training is not performed in a family-owned company so as to avoid conflict of interest.

**B) During Industrial Training**

(i)Once the student has reached the training place, he / she must send a mail to the Faculty coordinator Industrial Training / course coordinator and Training and Placement Officer that he / she has joined the training from _____ in the industry (Name)_____ and forward his / her contact nos., E-mail ID and the contact nos. of the company representative.

(ii)During the training, students will be given 3-4 practical problems by the industry in which they are undergoing training. In case the industry does not give them the problems, the students will themselves formulate minimum three problems and maximum four problems and carry out detailed study on them and recommend the optimum solution based on their theory knowledge.

(iii)To maintain discipline and abide by all rules and regulations enforced by the organization and to ensure **FULL** attendance during the Industrial Training duration.

(iv)To maintain confidentiality and to not disseminate / share any information related to the organization to third parties.

(v)To be responsible for maintaining the security of properties belonging to the organization.

**ASSESSMENT COMPONENTS**

Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Internship Programme. Students have to register for NPTEL courses to earn the same number of theory credits equivalent to regular courses of the institute and at the end of semester they will have to submit a course completion certificate. Students should be evaluated by the Training and Placement Officer, Faculty coordinator. Evaluation methods used may consist of the following: industrial training report, presentation by the student and viva-voce.

**DISCIPLINARY PROCEDURES DURING INDUSTRIAL TRAINING PROGRAMME**
Within the training period, the student is wholly responsible to the organization where he or she has been placed. This means that the student must observe specified office hours, and must

adhere to all rules and regulations of the organization, just like the other staff within the organization, during the entire training period.

**DEPARTMENTAL REPORT**

When the training of the student in an industry is completed, he / she should write a report. Report should include a description of the company, the processes and procedures followed in it. The report should also contain entire studies & discussions carried out by the students in addition to what he / she has observed during his / her day to day work. The report should be signed by the student and also by his officer-in-charge of that company.

**FORMAT OF INDUSTRIAL TRAINING REPORT**

The following titles must be incorporated in the final industrial training report:

1. Preface/Acknowledgement
2. Certificate with Signatures and Seal of the Industry Person
3. Contents/Index
4. Introduction about the Industry
5. Training Schedule
6. Work Done / Observations
7. Specific Assignment / Project Handled
8. Learning after Training
9. Summary

**EVALUATION THROUGH SEMINAR PRESENTATION**

The students will present his/her report through a seminar, which will be held by an expert committee constituted by the concerned department as per norms of the institute. The evaluation through seminar presentation will be based on the following criteria.

a) Quality of material presented.

b) Effectiveness of presentation.

c) Depth of knowledge and skills.

**R&D Project**

The primary objective of this Research and Development (R&D) project is to foster innovative thinking, enhance technical skills, and contribute to the advancement of knowledge in the field of Computer Science and Engineering. Through this project, the aim is to address a specific challenge, explore new possibilities, or improve existing solutions within the chosen domain. The project intends to achieve the following objectives:

1. **Problem Identification and Analysis:** Identify and define a specific problem, challenge, or opportunity within the Computer Science and Engineering domain. Conduct a thorough literature review to understand the existing solutions and research gaps.
2. **Research and Exploration:** Develop a comprehensive understanding of the theoretical foundations and practical aspects related to the identified problem. Explore various methodologies, techniques, and approaches that can be applied to address the problem.
3. **Innovation and Solution Development:** Propose innovative ideas, concepts, or solutions that have the potential to overcome the identified challenge. Design and develop a novel approach, system, product, or process based on the chosen solution.
4. **Implementation and Experimentation:** Implement the proposed solution in a controlled environment or through simulations. Conduct experiments, tests, or simulations to evaluate the effectiveness, efficiency, and feasibility of the developed solution.
5. **Data Collection and Analysis:** Collect relevant data from experiments, simulations, or real-world scenarios. Analyse the collected data to quantify the performance of the proposed solution and draw meaningful conclusions.
6. **Comparison and Evaluation:** Compare the results of the developed solution with existing methods or benchmarks. Evaluate the strengths, limitations, and practical applicability of the proposed solution.
7. **Documentation and Presentation:** Document the entire research process, including problem formulation, methodology, implementation details, results, and analysis. Create a comprehensive report/paper and presentation materials to effectively communicate the project's findings and contributions.

**Project Group and Supervisor:** A project group refers to a collaborative effort where students, under the guidance of a faculty member, work together on a specific problem, subtask of a larger problem, or a problem set. In such instances, it is essential to establish clear deliverables for each student within the group.

**Duration**: The project dissertation requires a minimum duration of approximately 12 to 16 weeks, with an expected completion by the final week of the semester in the relevant academic year.

**The project work allows for three possible approaches:**

1. Pursuing novel and innovative ideas.
2. Extending previous research efforts.
3. Tackling abstract or proof-of-concept problems.

**Deliverables**: The expected deliverables will consist of one or more of the following:

1. Software/hardware-based product addressing a real-world problem.
2. Embedded systems (software-hardware combined).
3. Research work presented in the form of conference/journal papers.
4. Comparative studies of products, methods, or designs.
5. Results from system design and simulation studies.
6. Theoretical modeling and technical studies.

In cases where certain projects do not neatly fit into the mentioned categories, the respective supervisor will identify specific deliverables for those projects. This process will require a comprehensive report and approval from higher authorities.

**Expectations from the student:** During the project tenure, students are expected to adhere to the following guidelines:

1. Completing the assigned project work provided by the supervisor and meeting all identified milestones promptly.
2. Following the work-plan established by their respective supervisor, which includes adhering to reporting procedures and complying with designated working hours throughout the project duration.
3. Submitting the project report in the prescribed format to the project coordinator only after obtaining approval from the supervisor, well before the due date.
4. Taking full responsibility for avoiding plagiarism and respecting copyright issues.

**Project Outcomes:**

The outcome of the project should be in the form of as followings:

1. Research Paper/Patent/Copyright.

2. Any winning position in hackathon/national or international competitions.

**General Instructions:**

1. Students need to consult with the faculties (based on area of expertise) to work on a R&D project. Students may work on this project either as a single member or form a group of 3 to 5 students. Any changes in group or supervisor(s) at any stage need proper justification and approval from higher authorities.
2. Students need to submit the project group details to the project coordinator by 2nd week of starting the semester. Project group details include project title, abstract, details group member, name of supervisor(s) and approval sign of concern supervisor(s
3. Evaluation will be carried out as following:

| Continuous Evaluation(last week of each month) | | | | End Term Evaluation (at the time of end term exam) | | | Total Marks |
|---|---|---|---|---|---|---|---|
| E1 | E2 | E3 | E4 | Report | Viva-Voce Presentation | Outcomes | |
| 10 | 10 | 10 | 10 | 20 | 20 | 20 | 100 |

4. Students must report the progress of the project work to the respective supervisor every week as given schedule in the class time table.
5. Continuous Evaluation (E1/E2/E3/E4) will be carried out by the respective supervisor(s) and marks will be submitted to the project coordinator by the end of every month.
6. End Term Evaluation will be carried out by both respective supervisors and project coordinator.

**Course Outcomes**

Upon completion of this course, the students will be able to:

**CO 1:** Improve their knowledge and skills relevant to their areas of specialization.

**CO 2:** Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.

**CO 3:** Acquire knowledge and skills to compete in the job market with this experience and exposure.

# Elective Subjects
# (For Third Semester)

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Digital Marketing |
| **Course Code** | MCA-3101 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To learn and apply the Digital Marketing strategies
2. To demonstrate the Website Traffic Analysis.
3. To understand and subsequently create strategic and targeted campaigns using digital media tools.

**Course Content**

**Module 1. Introduction to Digital Marketing**: Digital Marketing, Differences from Traditional Marketing, Return of Investments on Digital Marketing vs. Traditional Marketing, E Commerce, Tools used for successful marketing, SWOT Analysis of Business for Digital Marketing, Meaning of Blogs, Websites, Portal and Their Differences, Visibility, Visitor Engagement, Conversion Process, Retention, Performance Evaluation.

**Module 2. Search Engine Optimization (SEO)**: On page Optimization Techniques, Off Page Optimization Techniques, Preparing Reports, Creating Search Campaigns, Creating Display Campaigns. Social Media Optimization (SMO): Introduction to Social Media Marketing, Advanced Facebook Marketing.

**Module 3. Wordpress Blog Creation**: Twitter Marketing, Linkedln Marketing, Instagram Marketing, Social media Analytical Tools. Search Engine Marketing: Meaning and Use of Search Engine Marketing, Tools used: Pay Per Click, Google Adwords, Display Advertising Techniques, Report Generation.

**Module 4. Website Traffic Analysis**: Affiliate Marketing and Ad Designing: Google Analytics, Online Reputation Management, EMail Marketing, Affiliate Marketing, Understanding Ad Words Algorithm, Advertisement Designing.

**Module 5. AdWords Editor**: AdWords Editor, Creating optimized campaigns, Understanding AdWords, Editor options, Easy optimization of accounts, Analysis of accounts using AdWords

Editor, AdWords Editor shortcuts ,Analyzing existing accounts, Exporting accounts into different formats. Getting Your Company Ready for Social Media: Content Management, Scheduling & Creating content, Managing content programs, Trademark Implications, Working with Tumblr Influencers: Who are they? How to find them, How to use them to benefit your brand.

**Course Outcomes**

At the end of this course the student will be able to:

**CO 1:** Understand the concept of digital marketing and its real-world iterations.
**CO 2:** Articulate innovative insights of digital marketing enabling a competitive edge.
**CO 3:** Understand how to create and run digital media based campaigns.
**CO 4:** Identify and utilize various tools such as social media etc.

**List of Text Books**


1. Chaffey, Dave, and Paul Russell Smith. Digital marketing excellence: planning, optimizing and integrating online marketing. Taylor & Francis, 2022.
2. Big Book of Digital Marketing, Publisher: Digital Firefly Marketing, 2014.
3. J. Francesca, H. Durham.Fifty Shades of Digital Marketing, 2019.
4. D. Ryan, C. Jones, Understanding Digital Marketing, Publisher: Kogan Page, 2014.


**List of Reference Books**


1. T. Pineiro-Otero, X. Martinez-Rolan, Understanding Digital Marketing- Basics and Actions, Publisher: Springer International Publishing, 2016.
2. A. T. Jones, A. Malczyk, J. Beneke, Internet Marketing, Publisher: GetSmarter,2011

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Digital Forensics and Cyber Law |
| **Course Code** | MCA-3102 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the basics of digital forensics technology, systems, and services.
2. To learn about data recovery, data seizure, digital evidence controls, and forensics analysis.
3. To learn and develop different tools for digital forensic acquisition and analysis.

**Course Content**

**Module 1. Introduction to Digital Forensics**: Digital forensics fundamentals, Use of Computer Forensics, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Case Studies, Types of Computer Forensics Technology, Military, Law Enforcement, Business, Specialized Forensics Techniques, Protecting Data from Being Compromised, Internet Tracing Methods.

**Module 2. Digital Forensics Systems and Services:** Types of Computer Forensics Systems: Firewall and IDS Security Systems, Storage Area Network Security Systems, Instant Messaging (IM) Security Systems, Biometric Security Systems, Computer Forensics Services, Cyber Detectives, Fighting Cyber Crime with Risk Management Techniques, Computer Forensics Investigative Services, Forensic Process Improvement.

**Module 3. Digital Forensics Evidence and Capture:** Data Recovery, Data Recovery Solution, Hiding and Recovering Hidden Data, Evidence Collection and Data Seizure, Types of Evidence, The Rules of Evidence, Volatile Evidence

**Module 4. Data Preservation and Forensics Analysis:** Duplication and Preservation of Digital Evidence, Preserving the Digital Crime Scene, Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Evidence, Computer Image Verification and

Authentication,, Computer Forensics Analysis, Discovery of Electronic Evidence, Identification of Data, Reconstructing Past Events, Disk and file system analysis.

**Module 5. Network, Operating System Forensic:** Network forensics, Investigation on virtual network and Email, Email Tracing Internet Fraud, Internet Artifacts - Damaging Computer Evidence - System Testing - Operating System Artifacts: Windows System Artifacts, Linux System Artifacts.

**Module 6. Need for a Cyber Act:** Information Technology Act, Scope and further Development, Information Technology Act (Amendment), coverage of Cyber Security and Cyber Crime Indian cyber-Laws vs. cyber laws of U.S.A, similarities, scope and coverage, Effectiveness.

**Course Outcomes**

At the end of this course, the students will be able to:

**CO 1:** Learn the fundamentals of digital forensics technology along with different systems and services.

**CO 2:** Recover and seize data from a crime scene without damage, using legal procedures and standards.

**CO 3:** Exhibit knowledge in forensic data acquisition and analysis and investigate artifacts in different operating systems.

**List of Text Books**


1. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge 2022.
2. Marjie T Britz, Computer Forensics and Cyber Crime: An Introduction, 4th Edition, Pearson Education India, 2022.
3. Gerard Johansen, Digital Forensics and Incident Response: Incident response techniques and procedures to respond to modern cyber threats), Packt Publishing Limited, 2nd Edition, 2020.


**List of Reference Books**


1. B. Nelson, A. Phillips, F. Enfinger, C. Steuart, Guide to Computer Forensics and Investigations, Sixth Edition. Cengage, INDIA,ISBN: 9789353506261, 2019.
2. J. R. Vacca, Computer Forensics: Computer Crime Scene Investigation, Second Edition, Charles River Media, Inc. (ISBN No. : 978-1-58450-389-7), 2015.
3. G. Johansen, Digital Forensics and Incident Response: Incident response techniques and procedures to respond to modern cyber threats, 2nd Edition, Packet Publishing Limited,. ISBN 978-1838649005, 2020.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Third |
| **Course Name** | Real Time System |
| **Course Code** | MCA - 3103 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To learn various techniques to handle multiple processes at one time, ensuring that these processes respond to events within a predictable time limit.
2. To understand the basics of tasks, scheduling and real time communication.
3. To understand the logic of clock synchronization.

**Course Content**

**Module 1: Introduction**: Real Time System Characteristics, Issues in Real Time Computing, Structure of a Real Time System, Task classes, Performance Measures for Real time Systems, Task Assignment and Scheduling, Cyclic Scheduler, Event – Driven Scheduling, Rate Monotonic Scheduler, RMA Scheduling, Classical uniprocessor scheduling algorithms.

**Module 2: RM algorithm with Different Cases**-Priority ceiling precedence constraints- using of primary and alternative tasks, Deadline Monotonic Scheduling and Other Issues, Resource Sharing Among Real-Time Tasks.

**Module 3: Real Time Task Scheduling** on Multiprocessors and Distributed Systems, Clock Synchronization in Distributed Real-Time Systems, A Few Basic Issues in Real-Time Operating Systems.

**Module 4: Real Time Databases:** Real time Vs General purpose databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, two phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time System.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Develop real-time algorithm for task scheduling.

**CO 2:** Learned the working of real-time operating systems and real-time databases.

**CO 3:** Work on design and development of protocols related to real-time communication.

**List of Text Books**


1. Amos, Brian. Hands-On RTOS with Microcontrollers: Building real-time embedded systems using FreeRTOS, STM32 MCUs, and SEGGER debug tools. Packt Publishing Ltd, 2020.
2. A.Phillip Laplante**,**Real-Time Systems Design and Analysis, $4^{th}$ edition, Wiley, 2011.
3. M. K Albert. Cheng**,** Real-Time Systems: Scheduling, Analysis, and Verification, $1^{st}$ edition Wiley-Inter science, 2002.


**List of Reference Books**


1. A. Tanenbaum, H. Bos , Modern Operating Systems, $4^{th}$ edition , Pearson, 2008.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Unix and Shell Programming |
| **Course Code** | MCA-3104 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Operating System (MCA-1004)

**Course Learning Objectives**

1. To understand the UNIX operating system and its memory management, input/output processing, internal and external commands.
2. To learn the File Systems and Process Management of UNIX.
3. To learn and explore the use of operating system utilities such as text editors.
4. To understand Shell scripting and Shell Programming.

**Course Content**

**Module 1. Overview of UNIX**: Introduction of UNIX Operating System, Architecture, Kernel & Shell, Installation Process, Features, Internal And External Commands, Basic Commands: cal, date,echo, bc, script, passwd, PATH, who, uname, pwd, cd, mkdir, rmdir etc. Command Structure, Shell Script & Shell Programming.

**Module 2. File System:** Definition of File System, Boot Block, Super Block, Inode. File creations and its related commands cat, cp, rm, mv, more, file, ls, wc, pg, cmp, comm, diff. Zipping & unzipping files, gzip, tar, zip, df, du, mount, umount, etc. The vi editor. File Permissions with chgrp & chmod. Process Control: Viewing a Process, Command to display Process, Process Attributes, Process States, Process Fields, ps Commands options, Handling Jobs, Foreground & Background Jobs.

**Module 3. Redirection & Pipes:** Standard I/O Streams, Redirection & Pipes, Command Execution, Command-Line Editing, Quotes. Filters: Filters, Concatenating, Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Ordering a File. Regular Expressions: Atoms, operators, grep, sed, awk etc.

**Module 4. Shell Scripting**: Introduction to Shell, Types of Shell, C shell features, writing first script writing script, Executing & Debugging script. Shell Programming: Shell variables, Output, Input, exit Status of a Command, Branching Control Structures, Loop-Control Structure, and Continue and break Statements, Expressions, Command Substitution, Command Line Arguments and Functions.

**Module 5. Unix System Administration:** Adding and removing users. User accounting. Adding and removing hardware. Performing backups and restore. Disk space management. Unix system administration: Configuring the kernel. Network management in Unix. Performance analysis. Unix Desktop. Installation of Unix/Linux system – Unix/Linux Installation requirement, complete Procedure steps, Partitioning the Hard drive, System startup and shut-down process, init and run levels. File system mounting, lpstat, backup strategy, installing software on Unix/Linux.

**Course Outcomes**

At the end of this course the students will be able to:

CO 1: Identify and use UNIX utilities to create and manage simple file processing operations,

CO 2: Organize directory structures with appropriate security.

CO 3: Effectively use the UNIX system.

CO 4: Monitor system performance and lean the shell scripts.

CO 5: Use the shell scripts in designing a programs for engineering problems.

**List of Text Books**


1. S. Das,Unix Concept & Application, TMH,4th Edition,2017.
2. B.A. Forouzan, Unix & Shell Programming, Cengage Learning, 2004.
3. V. Murthy, Introduction to Unix &Shell, Pearson Edu, 2005.
4. Sarwar, Syed Mansoor, and Robert M. Koretsky. UNIX: the textbook. CRC Press, 2016.


**List of Reference Books**


1. Venkateswarlu, N. B. *Linux programming tools unveiled*. BS Publications, 2007.
2. Kanetkar, Yashavant P. *UNIX shell programming*. BPB publications, 2003.

# Elective Subjects
# (For Fourth Semester)

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Agile Software Development |
| **Course Code** | MCA-4101 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To provide theoretical as well as practical understanding of agile software development practices.
2. To provide a good understanding of software design and a set of software technologies and APIs.
3. To do a detailed examination and demonstration of Agile development and testing techniques.

**Course Content**

**Module 1. Agile Methodology:** Theories for Agile Management, Agile Software Development, Traditional Model vs. Agile Model, Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management, Agile Team Interactions, Ethics in Agile Teams, Agility in Design, Testing, Agile Documentations, Agile Drivers, Capabilities and Values.

**Module 2. Agile Processes:** Lean Production, SCRUM, Crystal, Feature Driven Development-Adaptive Software Development, Extreme Programming: Method Overview, Lifecycle, Work Products, Roles and Practices.

**Module 3. Agility and Knowledge Management:** Agile Information Systems, Agile Decision Making, Earls Schools of KM, Institutional Knowledge Evolution Cycle, Development, Acquisition, Refinement, Distribution, Deployment, leveraging, KM in Software Engineering, Managing Software Knowledge, Challenges of Migrating to Agile Methodologies, Agile Knowledge Sharing, Role of Story, Cards Story, Card Maturity Model (SMM).

**Module 4. Agility and Requirements Engineering:** Impact of Agile Processes in RE, Current Agile Practices, Variance, Overview of RE Using Agile, Managing Unstable Requirements, Requirements Elicitation, Agile Requirements Abstraction Model Requirements Management in Agile Environment, Agile Requirements Prioritization, Agile Requirements Modeling and Generation Concurrency in Agile Requirements Generation.

**Module 5. Agility and Quality Assurance:** Agile Product Development, Agile Metrics, Feature Driven Development (FDD), Financial and Production Metrics in FDD, Agile Approach to Quality Assurance, Test Driven Development, Agile Approach in Global Software Development.

**Course Outcomes**

At the end of this course the student will be able to:

**CO 1:** Realize the importance of interacting with business stakeholders in determining the requirements for a software system.
**CO 2:** Perform iterative software development processes: how to plan them, how to execute them.
**CO 3:** Point out the impact of social aspects on software development success.
**CO 4:** Develop techniques and tools for improving team collaboration and software quality.
**CO 5:** Perform Software process improvement as an ongoing task for development teams.
**CO 6:** Show how agile approaches can be scaled up to the enterprise level.

**List of Text Books**


1. Caldwell, Greg. Agile Project Management: The Complete Guide for Beginners to Scrum, Agile Project Management, and Software Development. Vol. 6. Alakai Publishing LLC, 2021.
2. D.J. Anderson, E. Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Result, Prentice Hall, 2003.
3. C. Larman, Agile and Iterative Development: A Managers Guide, 1st Edition, Addison-Wesley, 2004.


**List of Reference Books**


3. K. C. Desouza, Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, Penguin Books Ltd, 2007.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Soft Computing |
| **Course Code** | MCA-4102 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the underlying principle of soft computing with its usage in various applications.
2. To recognize the concept of fuzziness involved in various systems.
3. To design algorithm for optimization problem.

**Course Content**

**Module 1.Introduction:** Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing, Neuron-Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture, single layer and multilayer feed-forward networks, McCulloch Pitts neuron model, perceptron model, MLP-back propagation learning methods, effect of learning rule coefficient.

**Module 2. Architecture:** Counter propagation network, architecture, functioning & characteristics of counter, Propagation network - Hopfield/Recurrent network, configuration, stability constraints, associative memory, characteristics, limitations and applications, Hopfield v/s Boltzman machine, Adaptive Resonance Theory – Architecture, classifications, Implementation and training, Associative Memory.

**Module 3. Fuzzy Systems:** Different faces of imprecision, inexactness, Ambiguity, Undesirability, Fuzziness and certainty, Fuzzy sets and crisp sets, Intersections of Fuzzy sets, Union of Fuzzy sets, the complement of Fuzzy sets, Fuzzy reasoning, Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference, Methods of decompositions and defuzzification.

**Module 4. Optimization Algorithm:** Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free Parameters, Solution of typical control problems using genetic algorithm, Concept of some other search techniques like tabu search and ant colony, search techniques for solving optimization problems.

**Module 5. MATLAB Tool Box for Fuzzy Logic and Neural Network:** GA application to optimization problems, Case studies: Identification and control of linear and nonlinear dynamic

systems using MATLAB, Neural Network toolbox, Stability analysis of Neural Network interconnection systems, Implementation of fuzzy logic controller using MATLAB fuzzy logic toolbox, Stability analysis of fuzzy control systems.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Comprehend machine learning and soft computing techniques in solving real-world applications.
**CO 2:** Visualize and analyze behavioural patterns to develop an evolutionary algorithm.
**CO 3:** Design and develop ML techniques with the assistance of MATLAB.

**List of Text Books**


1. T. J. Ross, Fuzzy Logic with Engineering Applications, Third Edition, Wiley India, 2012.
2. Z. H. J., Fuzzy Set Theory and its Applications, Springer International Edition, 2011.


**List of Reference Books**


1. D. E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education, 2009.
2. A. Konar Artificial Intelligence and Soft Computing - Behavioural and Cognitive Modeling of the Human Brain, CRC Press,1999.
3. D. C., Attaway, Stormy. Matlab: A Practical Introduction to Programming and Problem Solving. Elsevier Science, 2013.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | DevOps |
| **Course Code** | MCA-4103 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To learn and understand about Development and Operational.
2. To provide in-depth knowledge on various DevOps tools including Git, Jenkins, Docker, Ansible.
3. To acquire knowledge on best practices in Continuous Development, Configuration Management and Continuous Integration, and finally, Continuous Monitoring of software throughout its development life cycle.

**Course Content**

**Module 1.Introduction of DevOps:** DevOps and Software, Development Life Cycle, Waterfall Model, Agile Model, Continuous Integration & Deployment, Jenkins Containers and Virtual Development, Docker, Vagrant, Configuration Management Tools, Ansible, Puppet, Chef.

**Module 2. Jenkins:** Continuous Integration with Jenkins, Configure Jenkins, Jenkins Management, Scheduling build Jobs, POLL SCM, Maven Build Scripts, Support for the GIT version control System, Types of Jenkins Jobs -Jenkins Build Pipeline, Parent and Child Builds, Sequential Builds, Jenkins Master & Slave Node Configuration, Jenkins Workspace Management. Securing Jenkins, Authentication, Authorization, Confidentiality, Creating Users, Jenkins Plugins, Installing Jenkins Plugins, SCM plugin, Build and test.

**Module 3. Version Control-GIT:** GIT Features - 3-Tree Architecture, GIT, Clone /Commit/ Push, GIT Hub Projects, GIT Hub Management, GIT Rebase & Merge, GIT Stash, Reset, Checkout, GIT Clone, Fetch, Pull. Build tool, Maven: Maven Installation, Maven Build requirements, Maven POM Builds (pom.xml), Maven Build Life Cycle- Maven Local Repository (.m2), Maven Global Repository, Group ID, Artifact ID, Snapshot -Maven Dependencies, Maven Plugins.

**Module 4. Ansible:** Introduction to Ansible, Ansible Server Configuration, Infrastructure Management, SSH Connection in Ansible Master, YAML Scripts, Host Inventory, Hosts and Groups, Host Variables, Group Variables, Host and Group Specific Data, Ad-hoc Commands, Playbooks, Variables, Conditionals, Loops, Blocks, Handlers, Templates, Modules, Core Modules, Extra Modules, Ansible Roles.

**Module 5. Docker :** Docker Image, Docker Image, Docker Installation, Working with Docker Containers, Container, Docker Engine, Crating Containers with an Image, Working with Images, Docker Command Line Interphase, Docker Compose, Docker Hub, Docker Trusted Registry, Docker swarm, Docker attach, Docker File & Commands.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Understand software development procedure.
**CO 2:** Apply various DevOps tools including Git, Jenkins, Docker, Ansible during problem solving.
**CO 3:** Analyze Version Control-GIT, Ansible and Docker.

**List of Text Books**


1. E. Freeman, DevOps For Dummies, First Edition, John Wiley & Sons, 2019.
2. B. Sosinsky,Cloud Computing Bible, First Edition, Wiley-India, 2010.
3. Sonatype Company, Maven The Definitive Guide, Second Edition, O'Reilly Media, 2015.


**List of Reference Books**


1. L. Hochstein, R. Moser, Ansible: Up and Running: Automating Configuration Management and Deployment the Easy Way, 2nd Edition, O'Reilly Media, Inc,2017.
2. A.Mouat, Using Docker: Developing and Deploying Software with Containers,1st Edition, O'Reilly Media,2016.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Resource Management |
| **Course Code** | MCA-4104 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To gain knowledge on theory of optimization and conditions for optimality for unconstrained and constrained optimization problems.
2. To gain knowledge on theory of optimization and conditions for optimality for unconstrained and constrained optimization problems.
3. To understand programming techniques and implement different optimization techniques to solve various models arising from engineering areas.

**Course Content**

**Module 1: Linear Programming (L.P)**: Revised Simplex Method, Dual simplex Method, Sensitivity Analysis DYNAMIC PROGRAMMING (D.P): Multistage decision processes. Concepts of sub optimization, Recursive Relation-calculus method, tabular method, LP as a case of D.P.

**Module 2: Classical Optimization Techniques**: Single variable optimization without constraints, Multi variable optimization without constraints, multivariable optimization with constraints -method of Lagrange multipliers, Kuhn-Tucker conditions. NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method.

**Module 3: Modern Methods of Optimization**: Genetic Algorithm (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, Genetic Operators- reproduction, crossover, mutation GENETIC PROGRAMMING (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, Random population generation. Fuzzy Systems: Fuzzy set Theory, Optimization of Fuzzy systems.

**Module-4: Integer Programming**: Graphical Representation, Gomory's Cutting Plane Method, Balas' Algorithm for Zero–One Programming, Branch-and-Bound Method. Application of Optimization in Design and Manufacturing System: Formulation of model-optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Formulate the Engineering Problems as an Optimization Problem.

**CO 2:** Use classical optimization techniques and numerical methods of optimization.

**CO 3:** Justify and apply the use of modern heuristic algorithms for solving optimization problems.

**CO 4:** Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.

**List of Reference Books**


1. K. Deb, Optimization for Engineering Design by, PHI Publishers, 2012
2. D.E.Goldberg, Genetic algorithms in Search, Optimization, and Machine learning, Addison-Wesley Publishers


**List of Reference Books**


1. F.S. Hillar, G.J. Liberman, Operations Research by, TMH Publishers, 10th Edition, 2017.
2. J. Arora,Optimum design, Mc Graw Hill (International) Publishers,2016.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Semester** | Fourth |
| **Year** | Second |
| **Course Name** | Brain Computer Interface |
| **Course Code** | MCA-4105 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the fundamental principles of neuroscience and brain signal processing.
2. To design and develop effective brain-computer interface systems for various applications.
3. To master signal processing and machine learning techniques for brain signal analysis and foster the ability to communicate complex BCI concepts.

**Course Content**

**Module 1. Introduction:** Introduction, Brain structure and function, Brain Computer Interface Types, Synchronous and Asynchronous, Invasive BCI, Partially Invasive BCI, Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

**Module 2. Brain Activation:** Brain activation patterns, Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement potential rhythms, motor imagery, Stimulus related potentials, Visual Evoked Potentials, P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

**Module 3. Feature Extraction Method:** Data Processing, Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering, Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction, Phase synchronization and coherence.

**Module 4. Machine Learning Methods for BCI:** Classification techniques, Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression, Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis.

**Module 5. Applications of BCI:** Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor, and robotic control using multi-electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs: P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain-Computer Interfacing**.**

**Course Outcomes**

At the end of the course, student will be able to:

**CO 1:** Comprehend and appreciate the significance and role of this course in the present contemporary world.

**CO 2:** Differentiate various concepts of BCI and allocate functions appropriately to the human and to the machine.

**CO 3:** Select appropriate feature extraction methods and design systems using machine learning algorithms for translation.

**List of Reference Books**


1. Rajesh. P. N. Rao, Brain-Computer Interfacing: An Introduction, Cambridge University Press, First edition, 2013.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, Brain Computer Interfaces: Principles and practices, Oxford University Press, USA, First edition, January 2012.


**List of Reference Books**


1. Ella Hassianien, A & Azar. A. T (Editors), Brain-Computer Interfaces Current Trends and Applications, Springer, 2015.
2. Brendan Z. Allison, Christoph Guger, Natalie Mrachacz-Kersting, Brain-Computer Interface Research: A State-of-the-Art Summary 7. Germany, Springer International Publishing, 2019.
3. Anton Nijholt, Chang S. Nam, Fabien Lotte, Brain–Computer Interfaces Handbook: Technological and Theoretical Advances. United States, CRC Press, 2018.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Ethical Hacking |
| **Course Code** | MCA-4106 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To evaluate the security of and identify vulnerabilities in target systems, networks or system infrastructure.
2. To learn how hackers work for gaining fame by bringing down a computer.
3. To learn about security testing methodologies.

**Course Content**

**Module 1. Introduction**: Overview of Ethical Hacking, Hacking concept, Need of Ethical hacking, Types of Hacking, Building the foundation for Ethical hacking, Hacking Phases, Role of Ethical Hacker, Types of Hackers, Roles and Responsibilities, Scope & limitations of hacking, Advantages & scope for hacking, Drawbacks & Limitation of hacking.

**Module 2. Cyber Threats**: Threats & its categories, Hacking tools and techniques, Common Hacking Tools, Hacking Techniques & Approaches, Policies and Controls Information Security policies, Risk Management & Incident Management, Information Security controls, Data Management, Concept of Penetration testing, Types of Penetration testing, Phases of Penetration testing.

**Module3. Viruses**: Introduction to Virus ,Worms & Trojan, Types of Virus, Worms & Trojan, Fake Antiviruses, Working of Antivirus, Malware Analysis, Malware Detection Method.

**Module 4. Foot Printing**: Sniffing, Social Engineering, Foot printing through Search Engines, Web Services, Information Gathering Using Google Advanced Search and Image Search, Foot printing through Google Hacking Database, Scanning Tools and Techniques, Scanning Pen Testing, Port Scanning & Countermeasures, Sniffing Network, Sniffing Concepts &

Techniques, WireShark installing & concept, Sniffing Detection Techniques, Social Engineering, Social Engineering Concepts, Social Engineering Techniques.

**Module 5. Case Study:** Study of Hacking in India & across the globe, Principles of Ethical hacking, Basic Principle, Commandments of Ethical Hacking, Hacking Methodologies.

**Course Outcomes**

At the end of course the students will be able to:

**CO 1:** Execute a penetration test using standard hacking tools in an ethical manner.
**CO 2:** Identify legal and ethical issues related to vulnerability and penetration testing.
**CO 3:** Report on the strengths and vulnerabilities of the tested network.

**List of Text Books**


1. Daniel Graham, Ethical Hacking-A Hands-on Introduction to Breaking In, No Starch Press, 2021.
2. P. Engebretson, The Basics of Hacking and Penetration Testing, Syngress; 2nd edition, 2013.
3. D.Stuttard, The Web Application Hacker's Handbook, 2nd Edition, Wiley, 2011.


**List of Reference Books**


1. G.Weidman, Penetration Testing,1st Edition, No Starch Press, 2014.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Principles of Compiler Design |
| **Course Code** | MCA-4107 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Formal Language and Automata Theory(MCA-4003)

**Course Learning Objectives**

1. To understand the theoretical foundations of compilers and their role in software development.
2. To learn the various phases of the compilation process and the interactions between them.
3. To develop proficiency in designing and implementing lexical analyzers, parsers, and semantic analyzers.

**Course Content**

**Module 1. Introduction to Compilers:** Role of compilers in software development, Structure of a compiler and its phases, Overview of compilation process, Lexical analysis and tokenization, Lexical analyzer generator tools, Lex.

**Module 2. Syntax Analysis:** Context-free grammars, top-down parsing- bottom-up parsing, LL (1) and LR(1) grammars, Parse tables and parsing algorithms, LL, SLR, LALR, LR, Parser generator tools, YACC.

**Module 3. Semantic Analysis:** Semantic errors and error recovery, Symbol tables and their organization, Type checking and type inference, Attribute grammars and semantic actions, syntax directed definition, bottom-up evaluation of S-attributed definitions, Intermediate representation.

**Module 4. Code Generation:** Overview of code generation, Target machine and runtime, environment, Three-address code and quadruples, Code generation for expressions, statements, and control structures, Activation records and runtime stack.

**Module 5. Code Optimization:** Principles of code optimization, Local optimizations, constant folding, common subexpression elimination, Global optimizations, data flow analysis, register

allocation, Loop optimizations and control flow optimizations, Code optimization tools and techniques.

**Module 6. Project Work:** Students work on a practical project related to compiler design, Implementation of a simple compiler for a subset of a programming language, Project involves multiple phases of compilation.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Explain the principles and functions of compiler design.

**CO 2:** Apply Syntax Analysis techniques to comply with and transform input according to the grammar of the language.

**CO 3:** Analyze different optimization techniques for code optimization.

**CO 4:** Design and Develop code generator and mini compiler for a language.

**List of Text Books**


1. K. D. Cooper, L. Torczon, Engineering a Compiler,Morgan Kaufmann, Second Edition, 2011.
2. A. V. Aho, M. S. Lam, R.Sethi, J. D. Ullman,Compilers: Principles, Techniques, and Tools, Pearson, Second Edition, 2006.


**List of Reference Books**


1. A. W. Appel,Modern Compiler Implementation in C/Java/ML, Cambridge University Press, Second Edition, 2002.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Second |
| **Semester** | Fourth |
| **Course Name** | Internet of Things |
| **Course Code** | MCA-4108 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Computer Network (MCA-4002)

**Course Learning Objectives**

1. To understand Smart Objects and IoT Architectures.
2. To learn about various IoT-related protocols.
3. To build simple IoT Systems using Arduino and Raspberry Pi.
4. To understand data analytics and cloud in the context of IoT.

**Course Content**

**Module 1. Overview of IoT:** An Architectural Overview, Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

**Module 2**. **Reference Architecture of IoT:** IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

**Module 3. Data Link Layer & Network Layer Protocols:** PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP.

**Module 4. Transport & Session Layer Protocols:** Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.

**Module 5. Service Layer Protocols & Security:** Service Layer -oneM2M, ETSI M2M, OMA, BBF, Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, RPL, Application Layer.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Explain the concept of IoT.
**CO 2:** Analyze various protocols for IoT.
**CO 3:** Design an IoT system using Raspberry Pi/Arduino.
**CO 4:** Apply data analytics and use cloud offerings related to IoT.

**List of Text Books**


1. D. Hanes, G. Salgueiro, P. Grossetete, R.Barton,J. Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
2. J. Holler, V. Tsiatsis, C. Mulligan, S. Avesand, S. Karnouskos, D. Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, First Edition, Academic Press, 2014.


**List of Reference Books**


1. A. Bahga, V. Madisetti, Internet of Things, A Hands on Approach, First Edition University Press, 2015.
2. R. Kamal, Internet of Things Architecture and Design Principles, McGraw Hill Education Private Lim., 2017.
3. M. Margolis, A. Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, Second Edition, O'Reilly Media, 2011.

# Elective Subjects
# (For Fifth Semester)

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third |
| **Semester** | Fifth |
| **Course Name** | Business Intelligence |
| **Course Code** | MCA-5101 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To understand the Business Intelligence, Analytics and Decision Support system.
2. To provide an overview of the sentiment analysis techniques.
3. To gain a better understanding of the technologies for Decision making, automated decision systems.
4. To illustrate Multi-Criteria Decision-making systems, predictive modelling techniques.

**Course Content**

**Module 1. Introduction:** Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, and Brief Introduction to Big Data Analytics.

**Module 2. Decision, Making Process:** The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.

**Module 3. Basic Concepts of Neural Networ**ks: Developing Neural Network-Based Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based Approach to the Use of SVM, Nearest Neighbor Method for Prediction, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process, Sentiment Analysis, Speech Analytics.

**Module 4. Decision Support Systems Modeling:** Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets,

Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making with Pairwise Comparisons.

**Module 5. Automated Decision Systems:** The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, and Development of Expert Systems.

**Course Outcomes**

On successful completion of the course, students should be able to:

**CO 1:** Analyse Business Intelligence, Analytics and Decision Support.

**CO 2:** Explain the technologies for Decision making..

**CO 3:** Apply predictive modelling and sentiment analysis techniques.

**List of Text Books**


1. R. Sharda, D.Delen, E.Turban, J.E.Aronson,T-P. Liang, David King, Business Intelligence and Analytics: System for Decision Support, 10th Edition, Pearson Global Edition, 2013.
2. J. Han, M. Kamber, J. Pei, Data Mining Concepts and Techniques, 2nd edition, Morgan Kaufmann, 2011.


**List of Reference Books**


1. G. Shmueli, N.R. Patel, P.C. Bruce, Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner, Wiley India,2005.
2. E. Mize,Data Analytics: The Ultimate Beginner's Guide to Data Analytics, 2017.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third |
| **Semester** | Fifth |
| **Course Name** | Natural Language Processing |
| **Course Code** | MCA-5102 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Artificial Intelligence and Machine Learning (MCA-4001)

**Course Learning Objectives**

1. To understand the core concepts, challenges, and applications of NLP.
2. To apply linguistic theories to analyze and process text data effectively.
3. To perform syntactic and semantic analysis of sentences and texts.
4. To apply NLP techniques to tasks like sentiment analysis and machine translation.

**Course Content**

**Module 1: Introduction to NLP:** Definition and Scope of NLP, Historical Developments and Milestones, Language Understanding and Generation, Challenges in NLP, Text Preprocessing, Tokenization, Stemming, Lemmatization, Stop Word Removal.

**Module 2: Linguistic Concepts and Language Modeling:** Basics of Morphology, Regular Expressions, Their Limitations, Finite-State Automata, N-grams and Language Modeling, Probability Distribution and Smoothing Techniques, Part-of-Speech Tagging, Hidden Markov Models, Viterbi Algorithm.

**Module 3: Syntax Analysis and Parsing:** Context-Free Grammars and Syntax Rules, Parsing Techniques: Top-Down, Bottom-Up, Efficient Parsing for Context-Free Grammars (CFGs), Statistical Parsing and Probabilistic CFGs (PCFGs).

**Module 4: Semantics Analysis and Sentiment Analysis:** Semantic Roles and Predicate-Argument Structures, Sentiment Analysis: Lexicon-Based and Machine Learning Approaches, Handling Sarcasm and Irony,

**Module 5: Advanced Topics in NLP:** Basics of Neural Networks and Backpropagation, Recurrent Neural Networks (RNNs), LSTMs, Word Embedding, Word2Vec, Rule-Based and

Statistical Machine Translation, Text Generation Techniques, Named Entity Recognition (NER), Discourse Analysis.

**Module 6: Ethical Considerations in NLP:** Bias and Fairness in NLP Models, Privacy Concerns And Data Anonymization, Social Implications Of AI And NLP Technologies, Future Directions And Research Areas, Students Choose An NLP Topic of Interest, Conduct Literature Review and Analysis, Present Findings and Implications.

**Course Outcomes**

At the end of this course the students will be able to:

**CO 1:** Comprehend the concepts of word-form using morphology analysis.
**CO 2:** Demonstrates n-gram models and POS tagging in English language.
**CO 3:** Acquire the knowledge of syntax and semantics related to natural languages.
**CO 4:** Acquire knowledge of machine learning techniques used in NLP**.**

**List of Text Books**


1. Eisenstein, Jacob. Introduction to Natural Language Processing. United Kingdom: MIT Press, 2019.
2. Dale R., Moisl H. and Somers H., Handbook of Natural Language Processing, CRC Press, 2nd Edition, 2010.


**List of Reference Books**


1. Bird S., Klein E. and Loper E., Natural Language Processing with Python, Oreilly Publication, 2nd Edition, 2009.
2. D. Manning, Christopher., Schütze, Hinrich. Foundations of Statistical Natural Language Processing, CreateSpace Independent Publishing Platform, 2016.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Fifth |
| **Semester** | Third |
| **Course Name** | Pattern Recognition |
| **Course Code** | MCA-5103 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To learn the designing of automated systems that improve their own performance through experience.
2. To learn the pattern based designing principle.
3. To learn how to apply the pattern based analysis and design to the software to be developed.

**Course Content**

**Module 1 Introduction:** Definition of Pattern Recognition, Feature Detection, Feature selection , Classification Review of Probability Theory, Conditional Probability, Regular Pattern, Irregular Pattern, Approaches to Pattern Recognition, Parametric, Non-Parametric Approaches, Search methods, Pattern Recognition Applications.

**Module 2 Discriminant Functions:** Decision surfaces, Classification algorithms: Naive Bayes, Random Tree, Decision Trees, Random Forest, Classification using SVM, Classification Review of Probability Theory, Classifier Ensembles, Linear Regression, Types of Clustering, K-Mean Clustering, ISO-data Clustering, Clustering Metrics, Clustering applications, Clustering tendency.

**Module 3 Fuzzy K-Mean:** Classifier Ensembles, Linear Regression, Semi Supervised learning, Fuzzy variants of classification, clustering algorithms, Neural networks fundamentals, Clustering, Vector Quantization.

**Module 4 Genetic Algorithms:** Genetic based approaches for Pattern recognition, Self-organizing maps, Advantages and Disadvantages of Neural based approaches for Pattern Recognition, Genetic Algorithms Combination for Multiple Classifiers.

**Module 5 Optimization Techniques:** Fisher Discriminant Sufficient Statistics, Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent, Density Estimation,

| |
|---|
| Parzen Estimation, Unsupervised Learning, Multi-layer Perceptron, Reinforcement Learning with Human Interaction. |
| **Course Outcomes** |
| At the end of this course the student will be able to:<br>**CO 1:** Learn to design patterns as a solution, and they can solve many problems that can be encountered in the future.<br>**CO 2:** Learn to analyze the success of a feature recognition system and understands the basic structure of pattern recognition systems.<br>**CO 3:** Learn to Select suitable pattern recognition techniques and effectively apply it to solve real-world problems. |
| **List of Text Books** |
| 1. Robert B. Macy, Abhijit S. Pandya, Pattern Recognition with Neural Networks in C++ , CRC Press , 2020.<br>2. E. Gose, R. Johnson Baugh, S. Jost,Pattern recognition and image processing, First Edition, Pearson, 2015.<br>3. R. Duda,P. Hart, D. Stork, Pattern Classification, Second edition John Wiley & Sons, 2000. |
| **List of Reference Books** |
| 1. Jianxin Wu, Essentials of Pattern Recognition-An Accessible Approach, Cambridge University Press, 2020.<br>2. Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, Third Edition , Academic Press, 2006.<br>3. Christopher M Bishop, Pattern Recognition and Machine Learning, Springer, 2006. |

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Fifth |
| **Semester** | Third |
| **Course Name** | Next Generation Networks |
| **Course Code** | MCA-5104 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Computer Networks (MCA-4002)

**Course Learning Objectives**

1. To understand the basic concepts IPV6.
2. To learn the basics of mobile telecommunication systems.
3. To gain knowledge about different mobile platforms and application development.
4. To understand about software defined networks.

**Course Content**

**Module 1. Basic Networking Principles & Concepts:** OSI and TCP/IP Model. IPv4 Revisited: Issues with IPv4 Address. Next Generation Internet Protocol: IPv6 – Introduction & Applications IPv6 Header Format Comparison of IPv4 and IPv6 Headers. IPv6 Addressing Model, IPv6 Address Abbreviation IPv6 Address Types- Unicast, Anycast, Multicast. IPv6 Address Scope: Link local, Unique Local, Global. Extended Unique Identifier: EUI:64 Subnetting in IPv6-I, Subnetting in IPv6- II, Subnetting in IPv6 – III, Auto configuration in IPv6 & it's different mechanisms. Stateless and Stateful auto configuration. DHCP for IPv6.

**Module 2. IPv6 Transition Mechanisms:** Dual Stack Tunneling-I Tunneling-II Header Translation. NAT Routing in IPv6: Introduction Comparison between different routing protocols for IPv4 and IPv6 Networks. RIP & RIPng OSPF & OSPFv3 BGP and BGP+. Mobility in IPv6- Issues and Direction towards research in IPv6 networks.

**Module 3. Overview of Wireless n/w. and Technologies:** Introduction, Different generations. Introduction to 1G, 2G,3G and 4G, Bluetooth, Radio frequency identification(RFID), Wireless Broadband, Mobile IP: Introduction, Advertisement, Registration, TCP connections, two level addressing, abstract mobility management model, performance issue, routing in mobile host, Adhoc networks, Mobile transport layer: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, transaction oriented TCP.

**Module 4. Wireless Application Protocol(WAP), MMS, GPRS application CDMA and 3G:** Spread-spectrum Technology, FHSS, DSSS, CDMA versus GSM, Wireless data, third

generation networks, applications in 3G Wireless LAN, WiFi v/s 3G Voice over Internet protocol and convergence, Voice over IP,H.323 framework for voice over IP, SIP, comparison between H.323 ad SIP, Real time protocols, convergence technologies, call routing, call routing, voice over IP applications, IMS, Mobile VoIP, Security issues in mobile Information security, security techniques and algorithms, security framework for mobile environment.

**Module 5. SDN Background and Motivation:** Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.

**Course Outcomes**

At the end of this course the student will be able to:

**CO 1:** Understand IPV6 deployment.
**CO 2:** Understand mobile and wireless network systems such as 2G/3G/4G mobile telephony/data networks,
**CO 3:** Understand advanced and emerging networking technologies.
**CO 4:** Learn how to use software programs to perform varying and complex networking tasks.

**List of Text Books**


1. S. Hagen, IPv6 Essentials, O'Reilly Media; 3rd edition, 2014.
2. A.K Telukder, R. R Yavagal, Mobile Computing, TMH, 2005.
3. K. Pahlavan, P.Krishnamurthy, Principle of wireless Networks, Pearson 2002.
4. T.D. Nadeau, K. Gray, SDN - Software Defined Networks, O'Reilly, 2013.
5. S. Azodolmolk, Software Defined Networking with OpenFlow, Packt Publishing, 2013.


**List of Reference Books**


1. J. Schiller, Mobile Communications, , Pearson, 2008.
2. ITI S. Misra, Wireless Communications and Networks, 3G and beyond, TMH,2017.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Fifth |
| **Semester** | Third |
| **Course Name** | Cryptography & Network Security |
| **Course Code** | MCA-5105 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Computer Networks (MCA-4002)

**Course Learning Objectives**

1. To learn the emerging concepts of cryptography and algorithms.
2. To explain how to secure a message over an insecure channel by various means.
3. To understand various protocols for network security to protect against the threats in the networks.

**Course Content**

**Module 1. Introduction to Cryptography:** Introduction to Cryptography, Types of Attacks, Symmetric Key Cryptography, Data Encryption Standard (DES), Differential and Linear cryptanalysis, Advanced Encryption Standard (AES), modes of operation, Stream Ciphers: Feedback shift registers, Asymmetric Key Cryptography, Applications of Asymmetric Cryptosystems, RSA Rabin, Elgamal, Probabilistic Cryptosystems, Elliptic Curve Cryptography (ECC), Diffie-Hellman key exchange protocol, Chinese Remainder Theorem (CRT).

**Module 2.Data Integrity and Authentication:** Message Authentication Code (MAC), Hash function properties, General model for iterated hash functions -MD5, Secure Hash Algorithms, HMAC, attacks on hash functions, Digital Signatures, X. 509 digital certificate, Kerberos, Zero-Knowledge Protocol

**Module 3. Firewalls and Web Security:** IPsec: AH and ESP, IKE- SSL/TLS, Secure Shell (SSH) application-OpenSSL, Packet filters, Application-level gateways, Intrusion detection and Prevention systems

**Module 4. Wireless Security:** DoS and DDoS attacks, Security issues and challenges in WSN, Wireless Application Protocol (WAP), Wireless LAN Security, Security in GSM

**Module 5. Advanced Cryptographic Techniques:** Multiparty Computation and Secret Sharing, Secret-Sharing Simulation, Security against Active Corruption-BGW Protocol (Active, Honest Majority), Homomorphic Encryption, Lattice Cryptography.

**Course Outcomes**

At the end of this course the student will able to:

**CO 1:** Analyze the cryptographic algorithms for Information Security.
**CO 2:** Identify and investigate network security threats.
**CO 3:** Identify the requirements for secure communication and challenges related to the Secure web services.

**List of Text Books**


1. J. Katz, Y. Lindell, Introduction to Modern Cryptography. Chapman & Hall/CRC Press, 2014
2. W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed. Pearson Publishers, 2017.
3. B. A. Forouzan,Cryptographyand Network Security:6th Ed. McGraw-Hill,2017.
4. D. Boneh, V. Shoup, A Graduate Course in Applied Cryptography, 2020.


**List of Reference Books**


1. R. Cramer, I. Bjerre Damgård, J. Buus Nielsen, Secure Multiparty Computation and Secret Sharing, ISBN 9781107043053, Cambridge University Press, 2015
2. D. R. Stinson, Cryptography: Theory and Practice, 3rd Ed. Boca Raton, FL: Chapman & Hall/CRC, ISBN No.:978-1-58-488508-5, 2005.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Fifth |
| **Semester** | Third |
| **Course Name** | Modelling and Simulations |
| **Course Code** | MCA-5106 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To introduce computer simulation technologies and techniques to form basis of simulation needs.
2. To implement and test a variety of simulations and data analysis libraries and programs.
3. To explore system behavior, outcomes prediction, and informed decision-making in various domains.

**Course Content**

**Module 1. Introduction of Simulation and Modelling:** Definition**,** Simulation Basics, Handling Stepped and Event-based Time in Simulations, Discrete versus Continuous Modelling, Numerical Techniques, Sources and Propagation of Error.

**Module 2. Simulations and Types:** Dynamical, Finite State, and Complex Model Simulations**,** Graph or Network Transitions based Simulations, Actor based Simulations, Mesh-Based Simulations, and Hybrid Simulations.

**Module 3. Data and Simulation Models:** Converting to Parallel and Distributed Simulations, Partitioning the Data, Partitioning the Algorithms, Handling Inter-partition Dependencies.

**Module 4. Probability and Statistics for Simulations and Analysis:** Introduction to Queues and Random Noise, Random Variates Generation, Sensitivity Analysis.

**Module 5. Simulations Results Analysis and Viewing Tools:** Display Forms: Tables, Graphs, Multidimensional Visualization, Terminals, X and MS Windows, and Web Interfaces, Validation of Model Result.

**Course Outcomes**

On completion of this course the student will be able to:

**CO 1:** Develop critical thinking skills in problem-solving by translating real-world issues into mathematical models and providing solutions through simulations.

**CO 2:** Understand the importance of validating and verifying models during estimation of model parameters and validate them through statistical analysis.

**CO 3:** Effectively communicate modeling results, assumptions, and recommendations through reports, presentations, and visual representations.

**List of Text Books**


1. (Editors) Bernard P. Zeigler, Lin Zhang, Yuanjun LaiLi, Model Engineering for Simulation. United Kingdom, Elsevier Science, 2019.
2. Madachy, Raymond J., and Houston, Daniel, What Every Engineer Should Know About Modeling and Simulation, United Kingdom, CRC Press, 2017.
3. Varenne, Franck, From Models to Simulations, United Kingdom, Taylor & Francis, 2018.


**List of Reference Books**


1. P.F.Möller Dietmar, Mathematical and Computational Modeling and Simulation: Fundamentals and Case Studies, Germany: Springer Berlin Heidelberg, 2012.
2. B. Allen, Downey, Modeling and Simulation in Python: An Introduction for Scientists and Engineers. United States: No Starch Press, 2023.
3. J.A. Sokololowski, C.M, Banks, Modeling and Simulation Fundamentals: Theoretical Underpinnings and Practical Domains, Germany: Wiley, 2010.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third |
| **Semester** | Fifth |
| **Course Name** | Mobile Application Development |
| **Course Code** | MCA-5107 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Fundamentals of Computer Programming using C (MCA-1001)
Object Oriented Programming (MCA-2003)

**Course Learning Objectives**

1. To learn to integrate strong mobile applications with other services.
2. To be able to create a seamless user interface that works with different mobile screens.
3. To create robust mobile applications and learning how to integrate them with other services.
4. To design and develop mobile applications using a Android application development.
5. To introduce the user interfaces that could make simple applications that run on Android phones and tablets.

**Course Content**

**Module 1. Android and Its Tools:** Android platform, java JDK and Android SDK, Android Development Tools (ADTs) and Virtual Devices (AVDs), Emulators, Dalvik Virtual Machine, Difference between JVM and DVM, Steps to install and configure Android studio and SDK. Anatomy of Android Application, Android Manifest file.

**Module 2. Android Applications and Design Essentials:** Android Application Design Essentials, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions, Multimedia Framework: Bluetooth, Animations, SQLite databases: Creation and Connection.

**Module 3. UI Components and Layout:** Control Flow, Directory structure, Components of a Screen, Fundamentals UI Design, Linear Layout, Absolute Layout, Frame layout, Table layout, Reliable Layout, Drawing and Working with Animation.

**Module 4. Testing Android Applications:** Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

**Module 5. Security and Application Deployment:** SMS Telephony, Location Based Services, Android Security Model, Declaring and using permission using custom permission, Become a Publisher, Developer Console.

**Course Outcomes**

At the end of this course student will be able to:

**CO 1:** To develop and design the user interfaces for Android platform.
**CO 2:** Save state data throughout significant operating system events.
**CO 3:** Apply Java programming principles to the creation of Android applications.
**CO 4:** Deploy the fully developed Android Application.
**CO 5:** Developing an app with the right set of features and functionalities that solve specific problems or fulfill user needs is crucial.

**List of Text Books**


1. L. Darcey, S. Conder, Android Wireless Application Development, Pearson Education, 2nd ed., 2011.


**List of Reference Books**


1. M. L. Murphy, Beginning Android, Wiley India Pvt Ltd, 2012
2. R. Meier, Professional Android 2 Application Development, Wiley India Pvt Ltd, 2018.
3. B. Burd, Android Application Development Allin one for Dummies, Edition: I, 2020.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third Year |
| **Semester** | Fifth Semester |
| **Course Name** | Quantum Computing |
| **Course Code** | MCA-5108 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To learn the quantum model of computation and the basic principles of quantum mechanics.
2. To understand quantum protocols such as teleportation and super dense coding.
3. To construct the quantum model related to classical models of deterministic and probabilistic computation.

**Course Content**

**Module 1. Qubits and Quantum States:** Introduction to Quantum Computing: Quantum Bits, Bloch Sphere Representation of a Qubit, Multiple Qubits. Classical & quantum information, quantum computing laws of physics, quantum information, quantum computers, vector spaces, postulates of quantum mechanics, linear combinations, basis & dimensions, inner products, Cauchy-schwart triangle inequalities.

**Module 2. Matrices & Operators** - Pauli operators, outer products & matrix representation, Hermitian, unitary & normal operators, eigenvalues and eigen vectors, characteristic equation, trace of an operator, expectation value of an operator, projection operators.

**Module 3. Quantum Gates and Circuits:** classical logic gates circuits, one qubit quantum gates, Hadamard gate, two qubit quantum gates- the CNOT gate, three qubit quantum gates- The Fredkin gate, The Toffoli gate, quantum circuits, universal quantum gates. Entanglement, exchange of information using entangled particles, Bell‘s states, Bipartite systems and the Bell basis.

**Module 4. Quantum Algorithms:** classical to quantum Turing machines, computational complexity and entanglement, classes of quantum algorithms, Deutsch‘s algorithm, The Deutsch-Josza Algorithm, Shor‘s Algorithm, Grover‘s Algorithm, Simon‘s algorithm, quantum search algorithm.

**Module 5. Quantum Cryptography:** information content in a signal, entropy and Shannon's information theory, deterministic versus probabilistic photon behavior, state description, superposition and uncertainty, measurement of superposition states, an augmented probabilistic model, a photon coincidence experiment, BB84-emergence of quantum cryptography.

**Course Outcomes**

At the end of this course the student will be able to:

**CO 1:** Understand the basic principles of Quantum Computing.

**CO 2:** Analyze conventional computing and quantum computing.

**CO 3:** Understand the Quantum Computing algorithms and Quantum Cryptography.

**CO 4:** Solve various problems by Quantum Computers.

**List of Text Books**


1. M. A. Nielsen, L. Isaac Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. de Vries, Quantum Computation: An Introduction for Engineers and Computer Scientists, Books on Demand, First Published Edition, 2012.
3. N. S. Yanofsky, Micro A. Mannucci, Quantum Computing for Computer Scientists, Cambridge University Press, First Published Edition, 2008.


**List of Reference Books**


1. D. McMahon, Quantum Computing Explained, John Wiley and Sons Inc, Ist Edition, 2008.
2. N. David Mermin, Quantum Computer Science-An Introduction, Cambridge University Press, I Edition, 2007.
3. R. Tipton Perry, Quantum Computing from the Ground Up, World Scientific Publishing Co. Pte. Ltd, Ist Edition, 2012.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Fifth |
| **Semester** | Third |
| **Course Name** | Bioinformatics |
| **Course Code** | MCA-5109 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

NA

**Course Learning Objectives**

1. To provide an overview of bioinformatics as an interdisciplinary field at the intersection of biology and computer science.
2. To familiarize with various biological databases, data sources, and resources.
3. To introduce the emerging trends and privacy issues associated with biological information.

**Course Content**

**Module 1. Introduction to Bioinformatics and Scoring Matrices:** Scope and applications of bioinformatics, Alignment of pairs of sequences, Introduction: Definition of sequence alignment, Methods, Dot matrix sequence comparison, Similarity searches, PAM and BlOSUM matrix, Dayhoff mutation matrix, construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM.

**Module 2. Sequence Alignment - Pairwise and Multiple:** Dynamic programming algorithm for sequence alignment, Global Alignment: Needleman Wunsch, Local Alignment: Smith-Waterman, Gap penalty, Assessing the significance of an alignment, Dynamic programming, progressive methods, Iterative methods, MSA using CLUSTAL W, PILEUP and CLUSTAL X, purpose and applications of multiple sequence alignment.

**Module 3. Databases and Data Sources in Bioinformatics:** Database searching for similar sequences. Sequence similarity search, FASTA sequence database similarity search, BLAST sequence database similarity search, and other methods of comparing databases of sequences and patterns.

**Module 4**. **Structural Bioinformatics:** Functional Annotation, Protein structure prediction, homology modeling, and protein databases, Docking and protein-ligand interactions, and molecular dynamics simulations.

**Module 5. Emerging Trends in Bioinformatics:** Current trends in bioinformatics, including single-cell sequencing, metagenomics, and personalized medicine, Ethical considerations in bioinformatics, privacy, and responsible data sharing.

**Course Outcomes**

At the end of the course, student will be able to:

**CO 1:** Acquire knowledge of the fundamental concepts and techniques that are used in computer science and are relevant to applications in bioinformatics.

**CO 2:** Explore the database formed of biometric systems and apply the evolving machine learning algorithms to the existing bioinformatics based systems.

**CO 3:** Comprehend and analyse bioinformatics systems, and improve them to strengthen traditional systems

**List of Text Books**


1. B. Heidelberg, Bioinformatics and Genome Analysis. Germany: Springer, 2013.
2. M.Yaseen Sofi, A.Shafi, K. Z.Masoodi, Bioinformatics for Everyone, Netherlands: Elsevier Science, 2021.
3. Yang, Zheng Rong, Machine Learning Approaches to Bioinformatics, Singapore: World Scientific, 2010.


**List of Reference Books**


1. Tiwary, Basant K., Bioinformatics and Computational Biology: A Primer for Biologists, Singapore, Springer Nature Singapore, 2021.
2. Bioinformatics Technologies, Germany: Springer Berlin Heidelberg, 2014.
3. Wroclaw, Algorithms in Bioinformatics: 14th International Workshop, WABI, Germany: Springer Berlin Heidelberg, 2014.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third Year |
| **Semester** | Fifth Semester |
| **Course Name** | Blockchain Architecture Design |
| **Course Code** | MCA-5110 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Computer Networks (MCA-4002)

**Course Learning Objectives**

1. To provide knowledge on Blockchain architecture.
2. To understand the design of Blockchain transaction and security issues.
3. To study about various use Cases in Blockchain.

**Course Content**

**Module 1. Fundamentals of Blockchain:** Blockchain: Importance and features, Layers of Blockchain: application layer, execution layer, semantic layer, propagation layer, consensus layer, Types of Blockchain, Blockchain in practical use today, Blockchain governance challenges, Blockchain technical challenges.

**Module 2. Blockchain for Enterprise:** Blockchain Components and Concepts, Block Header and Identifiers, Linking Blocks in the Blockchain, Mining and Consensus: Aggregating transactions into Blocks, Mining the Block, Validating and Assembling of Blocks, Selecting Chains of Blocks.

**Module 3. Transactions and Bitcoin Network:** Transactions: Lifecycle, Structure, Inputs and Outputs, Standard Transactions - Bitcoin Network: Network discovery for a new node, Block propagation.

**Module 4. Bitcoin Client:** Consensus in Bitcoin: Proof of Work (PoW), Mining the Block, Changing the Consensus Rules - Bitcoin Core: Bitcoin core application programming interface, running a bitcoin core node, Alternative clients, libraries and toolkits, Bitcoin Addresses: Implementing Keys and Addresses in Python –Wallets.

**Module 5. Security and Privacy Practices:** Security Architecture principles, Technical and inherent risks of the blockchain technology Attacks on Privacy: Blockchain and non-blockchain based Attacks, Risks and Limitations of Blockchain, User security best practices: physical bitcoin storage, hardware wallets, balancing risk, diversifying risk, multi signature and governance.

**Module 6. Blockchain Architecture and Applications:** Design methodology for blockchain applications: blockchain application templates, blockchain application development, Ethereum, Solidity, Deploying a sample application: Blockchain and betting, Colored coins, Counterparty, Blockchain Use Cases.

**Course Outcomes**

After completion of this course, the student shall be able to:

**CO 1:** Understand the requirements of the fundamentals of Blockchain.
**CO 2:** Identify and apply the concept of Bitcoin.
**CO 3:** Recognize the underlying technology of transactions, blocks and proof-of-work.
**CO 4:** Gain a deep insight into the Bitcoin network, Bitcoin miners and Bitcoin transactions.
**CO 5:** Design and explore the applications of Blockchain.

**List of Text Books**


1. B. Singhal, G. Dhameja, P. Sekhar Panda, Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, 1st edition, Apress, New York, 2018.
2. J. J. Bambara, P. R. Allen, Blockchain: a practical guide to developing business, law and technology solutions, 1st edition, McGraw-Hill publication, New York,2018.


**List of Reference Books**


1. S. Melanie, Blockchain: Blueprint for a new economy, 1st edition, O'Reilly Media, United States, 2015.
2. J. Thompson, Blockchain: The Blockchain for Beginnings, Guide to Blockchain Technology and Blockchain Programming, Create Space Independent Publishing Platform, 2017.
3. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Blockchain Technology: Cryptocurrency and Applications, Oxford University Press, 2019.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third Year |
| **Semester** | Fifth Semester |
| **Course Name** | Information Retrieval |
| **Course Code** | MCA-5111 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Artificial Intelligence and Machine Learning (MCA-4001)
Data Mining and Warehousing (CSE-4004)

**Course Learning Objectives**

1. To apply Information Retrieval (IR) concepts and Semantic Web technologies to design efficient search systems and enhance web-based information organization.
2. To summarize the process of information retrieval, compare and contrast different information retrieval models.
3. To interpret RDF (Resource Description Framework) and OWL (Web Ontology Language) concepts.

**Course Content**

**Module 1. Boolean Retrieval:** An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval. The term vocabulary and postings list, Document delineation and character sequence decoding, Tokenization, Stemming and lemmatization, Positional postings and phrase queries.

**Module 2. Dictionaries and Tolerant Retrieval:** Search structures for dictionaries, Wildcard queries, k-gram indexes for wildcard queries, Spelling correction, Index construction, Index compression,

**Module 3. Scoring, Term Weighting and Vector Space Model:** Parametric and zone indexes, Inverse document frequency, Tf-idf weighting, The vector space model for scoring, Variant Tf-idf functions, Computing scores in a complete search system, Components of an information retrieval system.

**Module 4. Evaluation in Information Retrieval:** Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, A broader perspective: System quality and user utility, XML retrieval. The Probability Ranking Principle, Language models for

information retrieval, The query likelihood model, Language modeling versus other approaches in IR, Extended language modeling approaches.

**Module 5. Semantic Web Vision:** Todays' web, Examples of the semantic web from today's web, Semantic web technologies, layered approach. Structured web documents in XML: The XML language, Structuring, Namespaces, Querying and Addressing XML documents, Processing.

**Module 6. Describing Web Resources:** Introduction, RDF, RDF Schema syntax and language, Direct Inference System, Querying RQL. Web Ontology Language: Introduction, OWL language, Examples, OWL in OWL, Future extensions.

**Course Outcomes**

After completion of this course, the student shall be able to:

**CO 1:** Construct information retrieval models and techniques for effective information extraction and ranking.

**CO 2:** Design and evaluate search algorithms to enhance the efficiency of information retrieval systems.

**CO 3:** Implement RDF and OWL constructs to build and query semantic data models.

**CO 4:** Apply knowledge of the course to real-world scenarios, fostering innovation in search and web-based information management.

**List of Text Books**


1. Manning, Christopher D. An introduction to information retrieval. Cambridge university press, 2015.
2. Grigoris Antoniou, Paul Groth, Frank van Harmelen, Rinke Hoekstra, A Semantic Web Primer, 3rd edition The MIT Press Cambridge, Massachusetts London, England, 2012.
3. Bruce Croft, Donald Metzler, Trevor Strohman, Search Engines: Information Retrieval in Practice, Pearson Education, 2011.


**List of Reference Books**


1. Bing Liu, Web Data Mining. Springer-Verlag Berlin Heidelberg 2011.
2. Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Morgan Kaufmann; First Edition 2002.

# Indian Institute of Information Technology, Bhopal
## Department of Information Technology

| | |
|---|---|
| **Name of Program** | Master of Computer Applications (MCA) |
| **Year** | Third Year |
| **Semester** | Fifth Semester |
| **Course Name** | Mobile Computing |
| **Course Code** | MCA-5112 |
| **Compulsory /Elective** | Elective |

**Prerequisites**

Computer Networks (MCA-4002)

**Course Learning Objectives**

1. To understand concepts of Mobile Communication.
2. To analyze the next generation Mobile Communication System.
3. To understand the concepts of Cellular and Telecommunication.

**Course Content**

**Module 1. Introduction of Mobile Computing:** History, Types, Benefits, Application, Evolution, and Security Concern regarding Mobile Computing, Different Propagation Modes, Wireless Architecture and its types, Needs of mobile user.

**Module 2. Cellular Concept:** Cellular system, Geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio.

**Module 3. Telecommunication System:** GSM, Channel allocation, Call routing Architecture, PLMN interface, Addresses and identifiers, Network aspects, Frequency allocation, authentication and security, Handoffs Technique. GPRS: Network operation, Data services, Applications, Billing and charging.

**Module 4**. **Mobile IP:** Need of mobile IP, IP packet delivery, Agent Discovery, Registration, Tunneling and encapsulation, Route optimization, IP Handoff.

**Module 5. Mobile Ad Hoc Wireless Networks:** Introduction, Benefits Difference, Routing protocols for ad hoc wireless networks: DSDV and AODV.

**Course Outcomes**

After completion of this course, the student will be able to:

**CO 1:** To understand network and transport layers of Mobile Communication.

| |
|---|
| **CO 2:** Analyze various protocols of all layers for mobile and ad hoc wireless communication networks.<br>**CO 3:** To understand IP and TCP layers of Mobile Communication. |
| **List of Text Books** |
| 1. A. K. Telukder, R. R Yavagal,Mobile Computing Technology, Applications and service creatio, TMH. Mobile Computing, Raj Kamal by Oxford, 2006.<br>2. W. Stallings,Wireless Communications & Networks, Second Edition, by Pearson, 2009. |
| **List of Reference Books** |
| 1. Garg, Mobile Computing Theory and Practice –Pearson, 2010.<br>2. B. A. Forouzan, TCP/IP Protocol Suite by Behrouz, Third Edition, TMH, 2005. |

*********END*********