



*“Education through self-help is our motto.”*

**Rayat Shikshan Sanstha's  
YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA  
(Autonomous)  
Lead College, Karmaveer Bhaurao Patil University**

**Reaccredited by NAAC with 'A+' Grade**

**Syllabus for Master of Science**

**Part - I**

**Computer Science**

**to be Implemented from June, 2023 onwards**

**(As Per NEP-2020 Guidelines)**

**Rayat Shikshan Sanstha's**  
**Yashavantrao Chavan Institute of Science, Satara**

**Syllabus for Masters of Science in Computer Science**

1. **Title:** M.Sc. Computer Science

2. **Year of Implementation:** 2023-24

3. **Preamble:** As per the NEP 2020 guidelines this updated syllabus is prepared for first year undergraduate students of Computer Science. Master of Science is an integrated academic degree in faculty of science. This is endeavour to initiate the process towards an era of knowledge. The students from science faculty should also be competent for this change in the technology. In this year, a student will able to understand Computer languages and technologies to build software with confidence. In the subject, the student will also get a basic and proper knowledge in the field of Artificial Intelligence and IOT.

**4. General Objectives**

- 1) To create post-graduates with sound knowledge of fundamentals of Computer Science, who can contribute towards advancing science and technology.
- 2) To create post-graduates with sufficient capabilities in Computer Science who can become researchers and developers to satisfy the needs of the core Computer Science Industry.
- 3) To develop ability among students to formulate, analyze and solve real life problems.
- 4) To provide opportunity to students to learn the latest trends in Computer Science and make them ready for life-long learning process.
- 5) To make the students aware of professional ethics of the industry, and prepare them with basic soft skills essential for working in community and professional teams.
- 6) To prepare the students for postgraduate studies through competitive examinations, enabling them to reach higher echelons of excellence.
- 7) To produce Computer Science professionals who can be directly employed or start his/her own work as Software Developer, Data Scientist, testing professional, Network engineer and even an entrepreneur in IT industry.

**5. Program Outcomes**

- 1) The students will graduate with proficiency in the computer science.
- 2) The students will be eligible to continue higher studies in the subject.
- 3) The students will be eligible to peruse higher education abroad.
- 4) The students will be eligible to appear for the examination for job in government sector.
- 5) The students will be eligible to appear for jobs with minimum requirement for M.Sc program.

## **6. Program Specific Objectives**

- 1) The students are expected to understand the fundamentals, principles, concept and recent developments in computer science.
- 2) The practical course is framed in relevance with theory courses to improve understanding of various concepts in computer science.
- 3) It is expected to inspire and boost interest of students in Computer Science.

## **7. Program Specific Outcomes**

- 1) Understand basics of computer science.
- 2) Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learnt in the classroom.
- 3) Develop the ability to apply the knowledge acquired in classroom and laboratories to specific problems in theoretical and experimental computer science.
- 4) Identify the area of interest in the academic research and development.
- 5) Perform job in various fields like IT, agriculture, healthcare, public services and business etc.
- 6) Be an entrepreneur with precision, analytical mind, innovative thinking, and clarity of thought, expression and systematic approach

**8. Duration:** One Year

**9. Pattern:** Semester wise

**10. Medium of Instruction:** English

## **A. RULES AND REGULATIONS:**

1. Any person who has taken the degree of B. Sc. of this Institute or the degree of any other statutory University and has kept four terms in the Institute as post-graduate student be admitted to the examination for the degree of Master of Science (M. Sc.) in Computer Science.
2. A student shall be held eligible for admission to the M. Sc. Computer Science course provided s/he has passed the B. Sc. examination with Computer Science as a principal subject or with a subsidiary/interdisciplinary/applied/allied subjects and has passed the entrance examination conducted by the Institute.
3. The students with B. Sc.(BCS/IT/B.Voc./Animation sci/Comp.Sci./B.C.A. Science) from other universities shall be eligible if they qualify through the entrance examination.
4. While preparing the merit list for M. Sc. admission, the performance at the performance at the entrance examination should be considered.
5. The examination shall be split up into four semesters.
6. The commencement and conclusion of each semester shall be notified by the Institute from time to time.
7. A student who has passed in semester examination shall not be allowed to take the examination in the same semester again.
8. Each theory Course in each semester as well as each practical course shall be treated as separate head of passing.
9. The result shall be declared at the end of each semester examination as per Institute

### Structure of the Course

Level	Sem	Major			RM	OJT	RP	Total
		DSC Mandatory		DSE Elective				
		T	P	T				
6	I	12 (3 Papers)	2	4 (1 paper out of two)	4	---	---	22
	II	12 (3 Papers)	2	4 (1 paper out of two)	---	---	4	22
6.5	III	12 (3 Papers)	2	4 (1 paper out of two)	---	---	6	22
	IV	12 (3 Papers)	---	4 (1 paper out of two)	---	4	---	22
Total		48	6	16	4	4	10	88
		70			8		10	

## M.Sc. Part I

### Semester I

<b>Nature of the Course</b>	<b>Course Code</b>	<b>Name of the Course</b>
Theory	MCST 411	DESIGN AND ANALYSIS OF ALGORITHMS
	MCST 412	PRINCIPALS OF PROGRAMMING LANGUAGE
	MCST 413	ADVANCED DATABASE MANAGEMENT SYSTEMS
	MCST 414 E-I	ADVANCED NETWORKING
	MCST 414 E-II	BLOCKCHAIN TECHNOLOGY
	MCST 415	RESEARCH METHODOLOGY
Practical	MCSP 416	PRACTICAL COURSE I: LAB I BASED ON (MCST 411,412,413)

### Semester II

<b>Nature of the Course</b>	<b>Course Code</b>	<b>Name of the Course</b>
Theory	MCST 421	PYTHON PROGRAMMING
	MCST 422	CLOUD COMPUTING
	MCST 423	CYBER SECURITY AND LAWS
	MCST 424 E-I	DIGITAL IMAGE PROCESSING
	MCST 424 E-II	MATHEMATICAL AND STATISTICAL FOUNDATIONS
	MCST 425	RESEARCH PROJECT
Practical	MCSP 426	PRACTICAL COURSE II: LAB II BASED ON (MCST 421,422,423)

## Semester I

### Course I

#### MCST411: Design & Analysis of Algorithms

#### Course Objectives: Student should able to...

1. learn the algorithms and to learn basic analysis techniques and understand the use of asymptotic notation.
2. understand different design strategies and greedy method.
3. identify classical problem and solutions and learn a variety of useful algorithms
4. understand classification of problems

<b>Credits=4</b>	<b>SEMESTER-I MCST411: Design &amp; Analysis of Algorithms</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I UNIT I</b>	<b>Unit I: Basics of Algorithms</b>	(15)
	Basics of Algorithms , Space complexity , Time complexity, worst case-best case-average case , complexity, asymptotic notation ,Recursive and non-recursive algorithms , Sorting algorithms (insertion sort, heap sort, bubble sort) ,Sorting in linear time: counting sort, concept of bucket and radix sort ,Searching algorithms: Linear, Binary, Divide and conquer strategy ,General method, control abstraction , Binary search, Merge sort, Quick sort , Comparison between Traditional Method of Matrix Multiplication vs. Strassen’s Matrix Multiplication	
<b>Credit –I UNIT II</b>	<b>Unit II: Greedy Method</b>	(15)
	Knapsack problem, Job sequencing with deadlines, Minimum-cost spanning trees: Kruskal and Prim’s algorithm , Optimal storage on tapes , Optimal merge patterns , Huffman coding , Shortest Path :Dijkstra’s Algorithm Graphs : Traversals, Topological sort, Minimum spanning trees, single source shortest path, All pair shortest path, Maximum flow problems.	
<b>Credit –I UNIT III</b>	<b>Unit III: Dynamic Programming</b>	(15)
	Principle of optimality,Matrix chain multiplication , 0/1 Knapsack Problem i)Merge & Purge ii)Functional Method , Bellman Ford Algorithm ,All pairs Shortest Path Floyd- Warshall Algorithm ,Longest common subsequence, ,String editing, Travelling Salesperson problem	
<b>Credit –I UNIT IV</b>	<b>Unit IV: Backtracking and Problem Classification</b>	(15)
	General method , Fixed Tuple vs. Variable Tuple Formulation , n- Queen’s problem • Graph coloring problem , Hamiltonian cycle , Sum of subsets Problem Classification - Nondeterministic algorithm • The class of P, NP, NP-hard and NP -Complete problems • Cook’s theorem	

**Course Outcomes: Students should be able to...**

1. explain Algorithmic complexity and analysing the same
2. develop an understanding of various techniques and methods to design algorithms
3. make and apply the algorithm and solve real-world problems
4. analyze traditional algorithms and apply to various problems.

**Reference Books:**

1. Sandeep Sen, “Design and Analysis of Algorithms: A Contemporary Perspective”, Cambridge University Press, 2029
2. Rajesh K. Shukla, “Analysis and Design of Algorithms: A Beginner's Approach”, Wiley, 2025.
3. Jungnickel, “Graphs, Networks and Algorithms”, Springer, 2022.
4. Steven Skiena, “The Algorithm Manual”, Springer, 2020.
5. T. Cormen, C. Leiserson, & R. Rivest, “Introduction to Algorithms”, MIT Press, 2009.
6. Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, “Computer algorithms”, Silicon Pr Publication, 2007



## Semester I

### Course II

#### MCST 412: Principles of Programming Language Learning

##### Course Objectives: Student will be able to...

1. introduce and compare programming language designs
2. learn new languages more quickly
3. understand basic language implementation techniques
4. learn small programs in different programming Languages

<b>Credits=4</b>	<b>SEMESTER-I</b> <b>MCST 412: Principles of Programming Language Learning</b>	<b>No. of hours</b> <b>per unit/</b> <b>credits</b>
<b>Credit –I</b> <b>UNIT I</b>	<b>Unit I: Introduction, Names, Scopes, and Bindings</b>	(18)
	The Art of Language Design, The Programming Language Spectrum, Study of Programming languages, Compilation and Interpretation , Programming Environments, The Notion of Binding Time, Object Lifetime and Storage Management, Static Allocation- (Stack-Based Allocation, Heap-Based Allocation, Garbage Collection Scope Rules),Static Scoping, Nested Subroutines, Declaration Order, Dynamic Scoping The meaning of Names in a Scope , Aliases, Overloading, Polymorphism and Related Concepts, the Binding of Referencing Environments, Subroutine Closures, First-Class Values and Unlimited Extent, Object Closures Macro Expansion	
<b>Credit –I</b> <b>UNIT II</b>	<b>Unit II: Functional Programming in Scala</b>	(12)
	Strings, Numbers, Control Structures, Classes and Properties, Methods, Objects, Functional Programming, List, Array, Map, Set	
<b>Credit –I</b> <b>UNIT III</b>	<b>Unit III: Data Abstraction and Object Orientation</b>	(15)
	Object-Oriented Programming, Encapsulation and Inheritance Modules, Classes, Nesting (Inner Classes), Type Extensions, Extending without Inheritance, Initialization and Finalization Choosing a Constructor, References and Values, Execution Order, Garbage Collection, Dynamic Method Binding, Virtual- and Non-Virtual Methods, Abstract Classes, Member Lookup, Polymorphism, Object Closures, Multiple Inheritance, Semantic Ambiguities, Replicated Inheritance	
<b>Credit –I</b> <b>UNIT IV</b>	<b>Unit IV: Control Flow</b>	(15)
	Expression Evaluation, Precedence and Associativity, Assignments, Initialization, Ordering Within Expressions, Short-Circuit Evaluation , Structured and Unstructured Flow, Structured Alternatives to goto, Sequencing, Selection - Short-Circuited Conditions, Case/Switch Statements Iteration , Iteration - Enumeration-Controlled Loops, Combination Loops, Iterators, Logically Controlled Loops Recursion, Recursion - Iteration and Recursion, Applicative- and Normal-Order Evaluation	

**Course Outcomes: Students should be able to...**

1. design and get knowledge of, and ability to use, language features used in current programming languages.
2. prepare student to think about programming languages analytically:
3. evaluate key concepts in the implementation of common features of programming languages.
4. implement object-oriented Programming concepts.

**Reference Books:**

1. Robert W. Sebesta, "Concepts of Programming Languages", Eighth Edition, Pearson Education, 2026
2. Michel L. Scott, "Programming Language Pragmatics", Kaufmann Publishers, An Imprint of Elsevier, USA, 2025
3. Rajiv Chopra, "Principles of Programming Languages", I K International Publishing House, 2024
4. Alvin Alexander, "Scala Cookbook", O'REILLY publication, 2023
5. Dowek, "Principles of Programming Languages", Springer, 2009.

**Semester I****Course III****MCST413: Advanced Database Management System****Course Objectives: Student will be able to...**

1. learn different types of databases.
2. study of query languages and active databases.
3. be familiar with the indexing techniques.
4. learn how to solve complex and recursive queries.

<b>Credits=4</b>	<b>SEMESTER-I</b> <b>MCST413: Advanced Database Management System</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> <b>UNIT I</b>	<b>Unit I: Query Processing and Evaluation</b>	(15)
	Measures of Query Cost, Selection Operation, Sort Join Operation, other Operations Evaluation of Expression, Transformation of Relational Expressions, Role of Relational Algebra and Relational Calculus in query optimization, Estimating Statistics of Expression, Choice of Evaluation Plans, Views and query processing, Storage and query optimization	
<b>Credit –I</b> <b>UNIT II</b>	<b>Unit II: Transaction Management and Recovery</b>	(15)
	Advanced feature of Transactions, Enhanced Lock Based and timestamp-based Protocols, Multiple Granularity, Multi-version Schemes, Deadlock Handling, Weak Levels of Consistency, Concurrency in Index Structures, Recovery and Atomicity, Recovery with Concurrent Transaction, Buffer Management, Advanced Recovery Techniques, Remote Backup Systems, Use of SQL in recovery, Examples of e-transactions.	
<b>Credit –I</b> <b>UNIT III</b>	<b>Unit III: Database Security and Authorization</b>	(15)
	Levels of database security, Access control, Multilevel security, Statistical database security, Audit trails in the databases, Examples of e security	
<b>Credit –I</b> <b>UNIT IV</b>	<b>Unit IV: Distributed Databases</b>	(15)
	Centralized versus non centralized Databases, Homogeneous and Heterogeneous DDBMS and their comparison, Functions and Architecture, Distributed database design, query processing in DDBMS, Distributed concurrency management, deadlock management, Distributed Commit Protocols: 2 PC and 3 PC, Concepts of replication servers	

**Course Outcomes: Students should be able to...**

1. demonstrate the basics of query evaluation and heuristic query optimization techniques.
2. apply Concurrency control and recovery mechanisms for the desirable database problem.
3. elaborate purpose of security details to database.
4. design and implement the database system with the fundamental concepts of DBMS.

**Text Books:**

1. R. Elmasri S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 2025
2. Raghu Ramakrishnan, Database Management Systems,Mcgraw-Hill,4th edition,2025

**Reference Books:**

1. A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 6th Edition 2020.
2. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2022
3. Pramod J. Sadalage and Marin Fowler, NoSQL Distilled: A brief guide to merging world of Polyglot persistence, Addison Wesley, 2022
4. Shashank Tiwari ,Professional NoSql, Wiley ,2021

**Semester I**  
**Course IV**  
**MCST414:E1: Advanced Computer Networks**

**Course Objectives: Student will be able to...**

1. understand the concept of security and its applications
2. study of various detection and prevention techniques in diversified environments
3. learn various vulnerabilities, threats and attacks
4. introduce globally competent post graduates with enhanced domain knowledge and skills attaining professional excellence

<b>Credits=4</b>	<b>SEMESTER-I</b> <b>MCST414:E1: Advanced Networking</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> <b>UNIT I</b>	<b>Unit I: Introduction to Network layers and Protocols</b>	(15)
	Introduction to networking, TCP/IP Protocol Model, IP Addressing- Address Space, Network Address Translation, Notations, Internet Protocol- Datagram format, fragmentation, IPV4, IPV6, Virtual Private network technology, Mobile IP – Addressing, Agents, Efficiency in Mobile IP.	
<b>Credit –I</b> <b>UNIT II</b>	<b>Unit II: Transport Layer Protocols</b>	(15)
	User Datagram Protocol-User datagram, UDP Services, UDP Applications, Transmission Control Protocol- TCP services, TCP Features, State Transition Diagram, Flow Control, Error Control, TCP congestion, SCTP- Services, features, flow control, error control.	
<b>Credit –I</b> <b>UNIT III</b>	<b>Unit III: Classification of Network Attacks &amp; Cryptographic Techniques</b>	(15)
	Basic Security Concepts, History Of Network Security, Data Security Vs. Network Security, Computer And Network Attacks, Introduction To Vulnerabilities, Threats And Attacks, Layers Of Attacks, Spoofing, Sniffing, Malware: Viruses, Worms, Trojan horses ,Ciphers, Cryptography- Cryptographic systems, Types of Cryptography: Symmetric key and Asymmetric Key Cryptography, Encryption and Decryption Techniques.	
<b>Credit –I</b> <b>UNIT IV</b>	<b>Unit IV: Application Layer &amp; Protocols</b>	(15)
	WWW, HTTP, File Transfer- FTP, TFTP, Electronic mail – architecture, web based mails ,email security, SMTP,POP,IMAP, MIME ,SNMP, DNS – Concept of domain name space, DNS Operations ,DHCP- Static and Dynamic allocation, DHCP operations, Remote Login – TELNET and SSH.	

**Course Outcomes: Students should be able to...**

1. design and choose appropriate security model
2. specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols.
3. use specific frameworks as per applications need.
4. evaluate working knowledge of datagram and internet.

**Reference Books:**

1. William Stallings, “Cryptography and Network Security: Principle and Practice”, Pearson, 5th Edition, 2027
2. B.M.Harwani , “Advanced Computer Networks”, DT Editorial Services, Dreamtech New Delhi-2024.
3. Tanenbaum, A. S., “Computer Networks”, Prentice Hall, Upper Saddle River, New Jersey, 5 th Ed., 2023
4. Mark Stamp, “Information Security: Principles and Practice”, John Wiley and Sons, 2021.
5. Behrouz A. Forouzan, “TCP/IP Protocol Suite”, McGraw Hill, 4th Ed., 2020.

**Semester I**  
**Course IV**  
**MCST414:E2: Blockchain Technology**

**Course Objectives: Student will be able to...**

1. understand the history, types and applications of Blockchain
2. acquire knowledge about cryptography and consensus algorithms.
3. study of how to deploy projects using Web3j
4. identify the design blockchain based applications.

Credits=4	SEMESTER-I MCST414:E2: Blockchain Technology	No. of hours per unit/ credits
<b>Credit –I</b> <b>UNIT I</b>	<b>UNIT 1: Introduction to Blockchain</b>	(15)
	Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.	
<b>Credit –I</b> <b>UNIT II</b>	<b>UNIT 2: Blockchain Architecture</b>	(15)
	Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)	
<b>Credit –I</b> <b>UNIT III</b>	<b>UNIT 3: Blockchain-Based Futures System</b>	(15)
	Project presentation- Futures smart contract: Blockchain oracles- Web3j: Setting up the Web3J- Installing web3j- Wallet creation, Java client: The wrapper generator- Initializing web3j- Setting up Ethereum accounts- Deploying the contract	
<b>Credit –I</b> <b>UNIT IV</b>	<b>UNIT 4: Blockchains in Business and Creating ICO</b>	(15)
	Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Blockchain-as-a-Service- Initial Coin Offering (ICO): Project setup for ICO implementation- Token contracts- Token sale contracts- Contract security and testing the code.	

**Course Outcomes: Students should be able to...**

1. discuss and describe the history, types and applications of Blockchain
2. explain familiarity with cryptography and Consensus algorithms.
3. create and deploy projects using Web3j.
4. implement an ICO on Ethereum

**Reference Books:**

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained”, 2nd Edition, Packt Publishing Ltd, March 2028.
2. Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, “Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger”, Packt Publishing Limited, 2028
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2026.
4. Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2025



## MCST 415: RESEARCH METHODOLOGY

### Course Objectives: Student will be able to...

1. study the basic knowledge on the fundamentals of research methodology.
2. understand to present research in scientific manner.
3. get acquainted with different statistical tools in modern research.
4. understand the relationship between computational research.

Credits4	MCST 415: RESEARCH METHODOLOGY	No. of hours per unit/ credits
<b>CreditI</b>	<b>UNIT I: Introduction to Research Methodology I</b>	<b>(15)</b>
	<p>A) Research Methods vs. Methodology</p> <p>i) Introduction.</p> <p>ii) Types: Library research, field research, laboratory research.</p> <p>B) Defining a Research Problem</p> <p>i) Concept.</p> <p>ii) Selecting the research problem.</p> <p>iii) Techniques involved in defining problem.</p> <p>iv) Conclusion of the problem.</p> <p>C) Research Design</p> <p>i) Need for research design.</p> <p>ii) Concept in research design.</p> <p>iii) Types of research design.</p> <p>D) Developing a Research Plan i) Need. ii) Essential characteristics of research plan.</p>	
<b>Credit I</b>	<b>UNIT II: Introduction to Research Methodology II</b>	<b>(15)</b>
	<p>A) Reporting Practical and Project Work</p> <p>i) Structure of report</p> <p>ii) Title, authors and their institution, abstract, keywords, abbreviations.</p> <p>iii) IMRAD technique a) Introduction b) Material and methods c) Result discussion and conclusion d) Acknowledgements.</p> <p>B) Preparing a Grant Proposal for Research Project</p> <p>C) Manuscript Submission to Research Journals</p> <p>i) Statement of proposal.</p> <p>ii) Ethical considerations.</p> <p>iii) Publishing editorial issues.</p> <p>iv) Preparation and submission.</p>	

<b>Credit I</b>	<b>UNIT III: Descriptive Statistics</b>	<b>(15)</b>
	<p>A) Importance of statistics in computer science</p> <p style="text-align: right;">i) Samples and Population</p> <p>ii) Types of data, random sampling methods and sampling errors, scales and variables, accuracy and precision.</p> <p>B) Measures of Central Tendency</p> <p>i) Mean (arithmetic, geometric, harmonic), median, percentile and mode.</p> <p>ii) Measures of dispersion – mean deviation, standard deviation and variance.</p> <p>iii) Measures of a) Skewness, b) Kurtosis.</p>	
<b>Credit I</b>	<b>UNIT IV: Hypothesis Testing</b>	<b>(15)</b>
	<p>A) Introduction to Hypothesis Testing</p> <p>i) Null hypothesis ii) Alternate hypothesis.</p> <p>B) Statistical Tools</p> <p>i) Significance level, type I and type II errors, p-value, one tailed and two tailed tests.</p> <p>ii) Distribution of sample means, standard error and confidence interval, Degrees of freedom</p> <p>iii) Equality of two population means, proportions: t-tests and z test</p> <p>iv) Chi square test - test for goodness of fit, independence and homogeneity</p> <p>v) F test and ANOVA</p>	

**Course Outcomes: Students should be able to...**

1. design a research plan.
2. present research in scientific language.
3. analyse research data employing computational tools.
4. statistically signify the importance of research data.

**References: -**

1. N. Gurumani, Scientific thesis writing and Paper presentation, (MJP Publishers, Chennai, 2010)
2. C. R. Kothari, Research Methodology; Methods and Techniques, 2nd Ed, (New Age International Publishers, New Delhi, 2004)
3. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3rd (Ukaaz, Publications, Hyderabad, 2004)
4. Robert R. Sokal and F. James Rohlf, Introduction to Biostatistics, 2nd Ed, (Dover Publications, INC. Mineola, New York, 1969)
5. P.N. Arora, P.K. Malhan, Biostatistics, (Himalaya Publishing House, Mumbai, 2006)

**M.Sc.Part-I, Sem.I**  
**MCSP 416 Practical**  
**(Based on MCST 411,412,413 courses)**

**Course Objectives: Student will be able to...**

1. understand how to implement different algorithms.
2. use the basics of SQL and construct queries using SQL.
3. study the basics of Computer Networks
4. understand implementation of Object-Oriented concepts.

Credits=2	SEMESTER-I	No. of hours per unit/ credits (60)
	<ol style="list-style-type: none"> <li>1. Write a program to implement Sorting Algorithms</li> <li>2. Write a program to implement Searching Algorithms</li> <li>3. Write a program to implement Warshall's Algorithm</li> <li>4. Write a program to implement Knapsack Problem</li> <li>5. Write a program to implement Shortest Paths Algorithm</li> <li>6. Write a program to implement Bellman Ford Algorithm</li> <li>7. Write a program to implement Minimum Cost Spanning Tree</li> <li>8. Write a program to implement All Pairs Shortest Paths</li> <li>9. Programs based on Control Structures               <ol style="list-style-type: none"> <li>a. Write a program to calculate average of all numbers between n1 and n2(eg.100 to 300 Read values of n1 and n2 from user)</li> <li>b. Write a program to calculate factorial of a number.</li> <li>c. Write a program to read five random numbers and check that random numbers are perfect number or not.</li> <li>d. Write a program to find second maximum number of four given numbers.</li> <li>e. Write a program to create two sets and find common elements between them.</li> <li>f. Write a program to display largest and smallest element of the Set</li> <li>g. Write a program to merge two sets and calculate product and average of all elements of the Set</li> </ol> </li> <li>10. Programs on Classes and Objects               <ol style="list-style-type: none"> <li>a. Create abstract class Order (id, description). Derive two classes PurchaseOrder&amp;SalesOrder with members Vendor and Customer. Create object of each PurchaseOrder and SalesOrder. Display the details of each account.</li> <li>b. Create abstract class Shape with abstract functions volume() and display(). Extend two classes Cube and Cylinder from it. Calculate volume of each and display it.</li> </ol> </li> <li>11. Programs on List               <ol style="list-style-type: none"> <li>a. Create Lists using five different methods(Lisp style, Java style, fill, range and tabulate methods)</li> <li>b. Create two Lists and Merge it and store the sorted in ascending order.</li> </ol> </li> <li>12. Implement DDL and DML</li> </ol>	

	13. Use of Single row and aggregate functions 14. Implement Joins and Sub queries 15. Write Anonymous blocks and control structures 16. Programs on Cursors 17. Programs on Functions and Procedures 18. Programs on Exception Handling and triggers 19. Programs on DBA Concepts 20. Programs on XML, DTD, XQuery Representations	
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**Course Outcomes: Students should be able to...**

1. understand and implement different algorithms.
2. apply cryptographic algorithms of encryption and description
3. perform the programs on Classes and Objects to implement Object Oriented concepts.
4. study of cursor,trigger and database.

**Reference Books:**

1. Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, “Computer algorithms”, Silicon Pr Publication, 2007.
2. T. Cormen, C. Leiserson, & R. Rivest, “Introduction to Algorithms”, MIT Press, 2009.
3. Steven Skiena, “The Algorithm Manual”, Springer, 2020.
4. Jungnickel, “Graphs, Networks and Algorithms”, Springer, 2022.
5. Rajesh K. Shukla, “Analysis and Design of Algorithms: A Beginner's Approach”, Wiley, 2025.
6. Sandeep Sen, “Design and Analysis of Algorithms: A Contemporary Perspective”, Cambridge University Press, 2029.
7. Michel L. Scott, “Programming Language Pragmatics”, Kaufmann Publishers, An Imprint of Elsevier, USA, 2025.
8. Robert W. Sebesta, “Concepts of Programming Languages”, Eighth Edition, Pearson Education, 2026.
9. Alvin Alexander, “Scala Cookbook”, O'REILLY publication, 2023.
10. Rajiv Chopra, “Principles of Programming Languages”, I K International Publishing House, 2024.
11. Dowek, “Principles of Programming Languages”, Springer, 2009.
12. Shashank Tiwari, ”ProfessionalNoSql”, Wiley, 2021.
13. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, - Pearson Education, 2008.
14. S Sridhar, “Digital Image Processing”, Oxford University Press, 2026.
15. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2026.

**SEMESTER II****Course V****MCST 202: Python Programming****Course Objectives: Student will be able to...**

1. understand of programming language paradigm.
2. introduce the Lambda Calculus.
3. identify functional programming language python.
4. learn and implement database concepts in python

<b>Credits=4</b>	<b>SEMESTER-II MCST 202: Python Programming</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I UNIT I</b>	<b>Unit I : Introduction To Python</b>	(15)
	Installation,Working with Python ,Understanding Python variables , Python basic Operators ,Understanding python blocks, Declaring and using Numeric data types: int, float, complex , Using string data type and string operations , Defining list and list slicing , Use of Tuple data type.	
<b>Credit –I UNIT II</b>	<b>Unit II: Python Program Flow Control</b>	(15)
	Conditional blocks using if, else and elif , Simple for loops in python , For loop using ranges, string, list and dictionaries , Use of while loops in python Loop manipulation using pass, continue, break and else , Programming using Python conditional and loops block , Modules And Packages , Organizing python codes using functions ,Understanding Packages	
<b>Credit –I UNIT III</b>	<b>Unit III: Python String, List And Dictionary Manipulations</b>	(15)
	Building blocks of python programs , Understanding string in build methods , List manipulation using in build methods , Dictionary manipulation Programming using string, list and dictionary in build functions , Reading config files in python , Writing log files in python , Read functions, read(), readline() and readlines() , Write functions, write() and writelines() , Manipulating file pointer using seek Programming using file operations	
<b>Credit –I UNIT IV</b>	<b>Unit IV: Python Database Interaction and Libraries</b>	(15)
	SQL Database connection using python , Creating and searching tables Reading and storing config information on database , Numpy , Pandas , Matplotlib , Scipy Only Introduction	

**Course Outcomes: Students should be able to...**

1. explain and use basics of Python
2. solve problems by using Python language.
3. evaluate projects by using Python Framework.
4. create application with help of python libraries.

**Reference Books:**

1. Greg Michaelson, "An Introduction to Functional Programming Through Lambda Calculus" ,Dover Publications Inc.,2021.
2. Jan van Eijck , Christina Unger, "Computational Semantics with Functional Programming", Cambridge University Press, 2022 .
3. Charles Dierbach , "Introduction to Computer Science Using Python: A Computational Problem-Solving Focus",John Wiley & Sons,2023.
4. Kenneth C. Loudon, "Programming Languages: Principles and Practice", Course Technology Inc., 2021.
5. Richard L. Halterman, "LEARNING TO PROGRAM WITH PYTHON", Southern Adventist University, 2021.
6. Dusty Phillips, "Python 3 Object-oriented Programming Second Edition", Packt Publishing, 2025
7. Adrian Holovaty and Jacob Kaplan-Moss, "The Definitive Guide to Web Development Done Right", Apress Publishing, 2020

**Semester II**  
**Course VI**  
**MCST 422: Cloud Computing**

**Course Objectives: Student will be able to...**

1. learn the principles and paradigm of cloud computing
2. study to appreciate the role of virtualization technologies
3. identify design and deploy cloud infrastructure
4. understand cloud security issues and solutions

<b>Credits=4</b>	<b>SEMESTER-II</b> <b>MCST 422: Cloud Computing</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> <b>UNIT I</b>	<b>Unit I: Introduction to Cloud Computing</b>	(15)
	Overview, Evolution of Cloud Computing, Types of Cloud, Desired Features of a Cloud, Benefits and Disadvantages of Cloud Computing, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Multitenant Technology. Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology. Infrastructure as a Service, Platform as a Service, Software as a Service, Cloud Deployment Models	
<b>Credit –I</b> <b>UNIT II</b>	<b>Unit II: Cloud Models &amp; Services:</b>	(15)
	Cloud Models – Benefits of Cloud Models, Public, Private, Hybrid, and Community Clouds , Types of Clouds Services: SaaS, PaaS, IaaS, DaaS, MaaS, CaaS. Service Providers: Google App Engine, Microsoft Azure, Amazon EC2, IBM, Sales Force; Introduction to MapReduce, GFS, HDFS, Hadoop Framework.	
<b>Credit –I</b> <b>UNIT III</b>	<b>Unit – III: Essentials &amp; Collaborating with Cloud:</b>	(15)
	Hardware and Infrastructure – Clients, Security, Network, Services; Accessing Cloud – Platforms, Web Applications, Web APIs, Web Browsers; Cloud Storage – Overview, Cloud Storage Providers; Standards – Application, Client, Infrastructure, Service; Centralizing Email Communications, Collaborating on Calendars, Schedules & Task Management, Event Management, Project Management and Contact Management	
<b>Credit –I</b> <b>UNIT IV</b>	<b>Unit IV: Virtualization and Security for Cloud</b>	(15)
	Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Provisioning in the Cloud Context Virtualization of CPU, Memory , I/O Devices, Virtual Clusters and Resource management, Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security	

**Course Outcomes: Students should be able to...**

1. explain the fundamental principles of distributed computing.
2. evaluate the distributed computing environments built from lower level services.
3. design the importance of virtualization in distributed computing and enabled the development of Cloud Computing.
4. analyse the performance of Cloud Computing.

**Reference Books:**

1. Brian J.S. Chee and Curtis Franklin, “Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center”, CRC Press, 2029.
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi , “Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill, 2023.
3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2022.



**Semester II  
Course VII**

**MCST 423: Cyber Security and Laws**

**Course Objectives: Student will be able to ...**

1. study the concepts of Cyber Security
2. understand and defend computer systems and networks from cyber security attacks
3. introduce the cyber law and Rights in Cyberspace
4. identify Cyber Torts and Dispute Resolution in Cyberspace

Credits=4	<b>SEMESTER-II MCST 423: Cyber Security and Laws</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I UNIT I</b>	<b>Unit-I Introduction to Cyber Security</b>	(15)
	<p>Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace. Cyber Security Vulnerabilities and Cyber Security Safeguards: Cyber Security Vulnerabilities Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.</p>	
<b>Credit –I UNIT II</b>	<b>Unit-II Securing Web Applications and Servers</b>	(15)
	<p>Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. Intrusion Detection and Prevention: Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.</p>	

<b>Credit –I UNIT III</b>	<b>Unit-III Introduction to Cyber Law and Rights in Cyberspace</b>	(15)
	Computer and its impact in society, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2023, Need for Cyber Law, Cyber Jurisprudence at Indian Level, Freedom of speech and expression in cyberspace, Right to access cyberspace-access to internet, Right to privacy, Right to data protection	
<b>Credit –I UNIT IV</b>	<b>Unit –IV Cyber Torts and Dispute Resolution in Cyberspace</b>	(15)
	Different offences under IT act,2000, Different types of civil wrongs under the IT act ,2000, Interface with copyright law, Interface with patent law, Concept of Jurisdiction, Indian context of Jurisdiction and IT Act,2000, Dispute resolutions, Impact of cyber warfare on privacy, identity theft, International law governing Censorship, online privacy, copyright regulations, Online Intermediaries in the governance of Internet, Social Networking Sites, Human Rights, Trademarks and Domain name related issue	

**Course Outcomes: Students should be able to...**

1. realize the need for Cyber Security
2. explain the need for Security in day to day communications
3. analyze the cyber law and rights in cyberspace
4. evaluate Cyber Torts and Dispute Resolution in Cyberspace

**Reference Books:**

1. John R. Vacca, “Computer and Information Security Handbook”, Morgan Kaufmann, 3<sup>rd</sup> Edition, 2027
2. Joseph Pelton , Indu B.Singh, “Digital Defense: A Cybersecurity Primer”, Copernicus, 2025
3. Brian Craig, “Cyberlaw: The Law of the Internet and Information Technology”, Lexis Nexis publishing, 2024
4. Jason Andress, Steve Winterfeld, “Cyber Warfare: Techniques, Tactics and Tools for Security Practitioners 2<sup>nd</sup> Edition “, Syngress publishing, 2023
5. Alfred Basta and Wolf Halton, Computer Security Concepts, Issues and Implementation, Cengage Learning, 2020
6. Preston Gralla, “How Personal and Internet Security Work”, Que Publications, 2004

**Semester II**  
**Course VIII**  
**MCST 424: E1:Digital Image Processing**

**Course Objectives: Student will be able to...**

1. learn the fundamental concepts of digital image processing.
2. study basic image processing operations.
3. understand image analysis algorithms.
4. identify current applications in the field of digital image processing.

Credits=4	<b>SEMESTER-II</b> <b>MCST 424: Digital Image Processing</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> <b>UNIT I</b>	<b>Unit I: Fundamentals of Image Processing</b>	(15)
	Steps in image processing, Human visual system, Sampling & quantization, Representing digital images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures. Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation. Image Histogram, Color fundamentals & models – RGB, HSI YIQ.	
<b>Credit –I</b> <b>UNIT II</b>	<b>Unit II: Image Enhancement, Restoration and Compression</b>	(15)
	Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement:2D DFT, Smoothing and Sharpening in frequency domain. Homomorphic filtering. Restoration: Noise models, Restoration using Inverse filtering and Wiener filtering. Types of redundancy, Fidelity criteria, Lossless compression – Run length coding, Huffman coding, Bit-plane coding, Arithmetic coding. Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG.	
<b>Credit –I</b> <b>UNIT III</b>	<b>Unit III: Image Segmentation and Morphological Operations</b>	(15)
	Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative – Prewitt and Sobel. Second order derivative – LoG, DoG, Canny. Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu’s Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.	

<b>Credit –I UNIT IV</b>	<b>Unit IV: Object Recognition and Applications</b>	(15)
	Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms, Minimum distance classifier, Correlation based classifier, Bayes classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical application of Image processing	

**Course Outcomes: Students should be able to...**

1. evaluate fundamentals of Image Processing
2. analyse image segmentation and morphological operations.
3. develop and implement algorithms for digital image processing.
4. apply image processing algorithms for practical object recognition applications.

**Reference Books:**

1. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image Processing”, Tata McGraw Hill Publication, 2027.
2. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, “Digital Image Processing Using MATLAB”, Second Edition, - Tata McGraw Hill Publication, 2020.
3. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, - Pearson Education, 2008.

**Semester II****Course IX****MCST424:E2: Mathematical and Statistical Foundation****Course Objectives: Student will be able to...**

1. introduce the notion of vector space.
2. study of to work out algebra of linear transformations.
3. identify the connection between linear transformation and matrices.
4. learn eigen values, eigen vectors and its connection with real life situation.

<b>Credits=4</b>	<b>SEMESTER-II MCST424:E1: Mathematical and Statistical Foundation</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I UNIT I</b>	<b>UNIT – I: Vector Spaces</b>	(15)
	Vector space, Subspace, Sum of subspaces, direct sum, Quotient space, Homomorphism or Linear transformation, Kernel and Range of homomorphism, Fundamental Theorem of homomorphism, Isomorphism theorems, Linear Span, Finite dimensional vector Space, Linear dependence and independence, basis, dimension of vector space and Subspaces.	
<b>Credit –I UNIT II</b>	<b>UNIT – II: Linear Transformations</b>	(15)
	Linear Transformation, Rank and nullity of a linear transformation, Sylvester’s Law, Algebra of Linear Transformations, Sum and scalar multiple of Linear Transformations. The Vector space of homomorphism, Product (composition) of Linear Transformations, Linear Operator, Linear functional, Invertible and nonsingular Linear Transformation, Eigen space, Characteristic Polynomial of a matrix and remarks on it, similar matrices, Characteristic Polynomial of a Linear operator, Examples on eigenvalues and eigenvectors.	
<b>Credit –I UNIT III</b>	<b>UNIT III: Statistical Modelling and Distributions</b>	(15)
	Overview of linear correlation and correlation, application and numerical examples on linear correlation and correlation. Introduction to Residual Error, Mean Square Error, RMSE, Multilinear correlation ,Regression, Logistic Regression, Simulation using Monte Carlo Method, Overview of Discrete and Continuous Probability Distributions, Binomial Distribution, Poisson ,Distribution ,Geometric Distribution, Exponential Distribution, Normal Distributions, Numeric Examples and Random No. Generation Using Python	
<b>Credit –I UNIT IV</b>	<b>UNIT IV: Hypothesis Tests and Statistical Tests</b>	(15)
	Typical Analysis procedures, Hypothesis Concept, Errors, p-Value, and Sample Size, Confusion Matrix, ANOVA, Test on Sample Mean, Comparison of Two Groups, Comparison of Multiple Groups, Categorical data analysis	

**Course Outcomes: Students should be able to...**

1. explain the concepts of basis and dimension of a vector space.
2. design eigen values, eigen functions, characteristic polynomial of a matrix.
3. analyse real world engineering problems by applying various statistical modeling techniques.
4. implement Model and solve computing problem using correlation, and resampling using appropriate statistics algorithms.

**Reference Books:**

1. Khanna V. K. and Bhambri S. K., "A Course in Abstract Algebra", Vikas Publishing House PVT Ltd., New Delhi , 5<sup>th</sup>Edition 2026.
2. H. Anton & C. Rorres, "Elementary Linear Algebra (with Supplemental Applications)", Wiley India Pvt.Ltd (Wiley Student Edition), New Delhi, 11<sup>th</sup>Edition 2026.
3. David Lay, Steven Lay, Judi McDonald, "Linear Algebra and its Applications", Pearson Education Asia, Indian Reprint, 5<sup>th</sup> Edition 2026
4. Thomas Haslwanter, "An Introduction to Statistics with Python with Applications in the Life Sciences", Springer International Publishing Switzerland 2026.
5. S. Friedberg, A. Insel, L. Spence, "Linear Algebra", Prentice Hall of India, 4<sup>th</sup> Edition, 2024.

**MCST 425: RESEARCH PROJECT**

<b>Credits</b> 4	<b>MCST 425: RESEARCH PROJECT</b>	<b>No. of hours- 60</b>
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**Semester II**  
**MCSP 426- Practical Course**  
**(Based on MCST 421,422,423 courses)**

**Course Objectives: Student will be able to...**

1. identify, read and write files in Python and use libraries of Python.
2. understand the basics of images, image transformations, Image Color Processing.
3. learn system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain.
4. study of the principles of best practice in cloud application design and management

Credits=2	SEMESTER-II Lab-II	No. of hours per unit/ credits (60)
	<ol style="list-style-type: none"> <li>1. Introduction To Python Installation of Python on different OS Working with Python as a calculator</li> <li>2. Programs on Flow Control Basic programs for understanding of different control flow in Python</li> <li>3. Functions Writing Programs using functions Use of Modules Use of packages</li> <li>4. Python programs for String, List Building blocks of python programs Understanding string in build methods List manipulation using in build methods</li> <li>5. Dictionary Manipulations Dictionary manipulation Programming using string, list and dictionary in build functions</li> <li>6. Python File Operation Reading config files in python Writing log files in python read functions, read(), readline() and readlines() write functions, write() and writelines()</li> <li>7. Python Libraries Numpy Pandas and Matplotlib Scipy</li> <li>8. Working and Implementation of Infrastructure as a service.</li> <li>9. Working and Implementation of Software as a service.</li> <li>10. Working and Implementation of Platform as a services.</li> <li>11. Practical Implementation of Storage as a Service.</li> <li>12. Working of Google drive to make spreadsheet and notes.</li> <li>13. Working and Implementation of identity management.</li> <li>14. Write a program for web feed.</li> <li>15. Execute the step to Demonstrate and implementation of cloud on single sign on.</li> <li>16. Study of the features of firewall in providing network security and to set Firewall Security in windows.</li> <li>17. Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)</li> <li>18. Study of different types of vulnerabilities for hacking a websites / Web Applications.</li> <li>19. Analysis the security vulnerabilities of E-Mail Application</li> <li>20. Case Study on – Cyber Harassment, Cyber Laws and Patent Law</li> </ol>	



**Course Outcomes: Students should be able to...**

1. evaluate the fundamental principles of distributed computing.
2. explain modelling of discrete systems in state space.
3. predicts value of one variable when other is known by using technique of regression analysis.
4. implement object oriented concepts, implement database and GUI applications.

**Reference Books:**

1. Greg Michaelson, "An Introduction to Functional Programming Through Lambda Calculus", Dover Publications Inc., 2021.
2. Jan van Eijck, Christina Unger, "Computational Semantics with Functional Programming", Cambridge University Press, 2022.
3. Charles Dierbach, "Introduction to Computer Science Using Python: A Computational Problem-Solving Focus", John Wiley & Sons, 2023.
4. Kenneth C. Loudon, "Programming Languages: Principles and Practice", Course Technology Inc., 2021.
5. Richard L. Halterman, "LEARNING TO PROGRAM WITH PYTHON", Southern Adventist University, 2021
6. Dusty Phillips, "Python 3 Object-oriented Programming Second Edition", Packt Publishing, 2025.
7. Adrian Holovaty and Jacob Kaplan-Moss, "The Definitive Guide to Web Development Done Right", Apress Publishing, 2009.
8. Brian J.S. Chee and Curtis Franklin, "Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center", CRC Press, 2029.
9. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing: Foundations and Applications Programming", McGraw Hill, 2023.
10. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2022
11. Jason Andress, Steve Winterfeld, "Cyber Warfare: Techniques, Tactics and Tools for Security Practitioners 2nd Edition", Syngress publishing, 2023.
12. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, - Pearson Education, 2008.
13. S Sridhar, "Digital Image Processing", Oxford University Press, 2026.
14. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, "Digital Image Processing Using MATLAB", Second Edition, - Tata McGraw Hill Publication, 2020.
15. S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", Tata McGraw Hill Publication, 2027.