ACADEMIC CURRICULA 2025 - 2027

M.Sc. in Computer Science

Detailed Syllabi

KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY

Deemed to be University U/S 3 of the UGC Act, 1956

SCHOOL OF COMPUTER APPLICATIONS

COURSE STRUCTURES & SYLLABI

M.Sc. in Computer Science
(2025– 2027)
Kalinga Institute of Industrial Technology
(Deemed to be University)

KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
Deemed to be University U/S 3 of the UGC Act, 1956
SCHOOL OF COMPUTER APPLICATIONS

PROGRAMME EDUCATIONAL OBJECTIVES

The students are expected to accomplish the following objectives after M.Sc. graduation:

PO1: Pursue a successful career in the field of computer science, contribute significantly to their profession in industry, research and academia or undertake entrepreneurial endeavours.

PO2: Continuously learn, engage and update them to carryout independent or collaborative research, and address constantly evolving technological and global challenges in their field of expertise.

PO3: Develop leadership skills and demonstrate professional, social and ethical responsibilities as an individual.

PROGRAMME OUTCOMES

M.Sc. programme is designed to ensure that each student acquires the desired competencies and on successful completion of the programme, the students are expected to:

PO1: Computational knowledge: Apply the knowledge of mathematics and computer fundamentals to solve real life problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex problems in their program of study using knowledge of mathematics and computer science.

PO3: Design/development of solutions: Design solutions for complex problems and design software components that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use application-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern IT tools to model complex solutions with an understanding of their limitations.

PO6: The professional and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.

PO7: Environment and sustainability: Understand the impact of the professional solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the software professional practices.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex technical activities with the community and with society at large, write and present substantial technical reports/ documents, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the software and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Ability to demonstrate a degree of mastery in the area of computer applications through the advanced knowledge of data acquisition, data analytics, big data, pattern recognition and knowledge discovery.

PSO2: Ability to independently carry out research/investigation and developmental work to solve practical problems.

PSO3: Develop sound knowledge and skill sets to develop and expand professional careers in fields related to human-computer interaction and management of industrial processes for the design and implementation of intelligent systems.

M.Sc. in Computer Science

COURSE STRUCTURE

(2025-2027)

FIRST SEMESTER (AUTUMN)

THEORY						
SL. NO.	**SUBJECT CODE**	**SUBJECT**	**L**	**T**	**P**	**CREDIT**
1	MS4101	Programming and Data Structures	3	-	-	3
2	MS4103	Theory of Computation	3	-	-	3
3	MS4105	Discrete Mathematics	3	-	-	3
4	MS4107	Database Management System	3	-	-	3
5	MS4109	Operating Systems	3	-	-	3
PRACTICAL						
6	MS4191	Programming and Data Structures Lab	-	-	4	2
7	MS4195	Soft Skills Lab	-	-	2	1
8	MS4197	Database Management System Lab	-	-	4	2
SESSIONAL						
9	YG-1081	Yoga and Human Consciousness	-	-	2	1
TOTAL						**21**

SECOND SEMESTER (SPRING)

THEORY						
SL. NO.	**SUBJECT CODE**	**SUBJECT**	**L**	**T**	**P**	**CREDIT**
1	MS4102	Computer Networks	3		-	3
2	MS4104	Design and Analysis of Algorithms	3	1	-	4
3	MS4106	Object Oriented Programming	3		-	3
4	MS4108	Optimization Techniques	3	-	-	3
5	MS4112	Artificial Intelligence	3			3
PRACTICAL						
6	MS4192	Java Lab	-	-	4	2
7	MS4194	Machine Learning Lab			4	2
TOTAL						**20**

THIRD SEMESTER (AUTUMN)

THEORY						
SL. NO.	**SUBJECT CODE**	**SUBJECT**	**L**	**T**	**P**	**CREDIT**
1	MS5101	Big Data Analytics	3	-	-	3
2	MS5103	Information and Cyber Security	3	1	-	4
3	MS5105	Cloud Computing	3		-	3
4		Elective-I	3	-	-	3
5		Open Elective	3	-	-	3
PRACTICAL						
6	MS5191	Data Analytics Lab	-	-	4	2
TOTAL			-	-	-	**18**

FOURTH SEMESTER (SPRING)

THEORY						
SL. NO.	**SUBJECT CODE**	**SUBJECT**	**L**	**T**	**P**	**CREDIT**
1	MS5102	Soft Computing	3		-	3
2		Elective - II	3	-	-	3
3		Elective-III	3	-	-	3
SESSIONAL						
4	MS5182	Project Work	-	-	-	12
TOTAL			-	-	-	**21**

M.Sc.	1st Sem	2nd Sem	3rd Sem	4th Sem	Total Credits
Credits	21	20	18	21	80

ELECTIVES

ELECTIVE – I	
COURSE CODE	**COURSE**
MS5123	Internet of Things
MS5125	Wireless Sensor Network

MS5129	Management Support System
MS5131	Compiler Design
MS5127	Mobile Computing
ELECTIVE – II	
COURSE CODE	**COURSE**
MS5122	Data Mining
MS5124	Computer Graphics
MS5126	Blockchain Architecture
MS5128	Formal Language and Automata Theory
MS5132	Geographic Information System
ELECTIVE – III	
COURSE CODE	**COURSE**
MS5142	Natural Language Processing
MS5144	Organizational Behaviour
MS5146	Graph Algorithm
MS5148	Advanced Algorithm
MS5152	Computer Vision

DETAILED SYLLABI

FIRST SEMESTER

MS4101 PROGRAMMING AND DATA STRUCTURES CREDITS-3

UNIT - I

C Language Fundamentals I: Character set, Identifiers, keywords, data types, Constants and variables, statements, expression, operators, precedence of operators, Input-output, control statements, control structures.

UNIT - II

C Language Fundamentals II: Arrays, functions, strings, recursion, Tower of Hanoi problem, storage classes, structures, Union, pointer and File Handling.

UNIT - III

Development of Algorithms: Notations and Analysis. Storage representation of array, sparse matrix, Insertion and Deletion from an array, merging of two sorted arrays, Stacks and Queues, Application of stack: Infix to Postfix expression, Evaluation of Postfix expression.

Sorting and Searching Techniques: Selection sort, Bubble sort, Heap sort, Quick sort, linear search, Binary Search.

UNIT - IV

Linked Lists: Singly linked lists, linked stacks and queues, Operations on Polynomials, Linked Dictionary, Doubly Linked Lists, Circular Linked Lists. Dynamic Storage Management.

Binary Tress: Binary search Tree, General Trees, Tree Traversing, Operations on Binary Trees, Expression Tree, Height Balanced Trees.

Graphs: Representation of Graphs - BFS, DFS, Hash Table Methods.

Reference Books:

1. *Reema Thareja, Data Structures Using C, 2nd edition, Oxford University Press, 2014.*
2. *E. Balagurusamy, Data Structures Using C, MGH, 2013*
3. *Forouzan, B.A. & Gilberg, R. : C Programming and Data Structures, 3rd Ed., Cengage, 2019*
4. *Horowitz, E. & Sahni, S. : Fundamentals of Data Structures in C, Universities Press*
5. *Ritika Mehera: Data Structures Using C, Pearson Education.*
6. *Chandan Banerjee & A. Das: Data Structures and Algorithms in C and PYTHON, Universities Press.*
7. *Amiya K. Rath & A.K. Jagadev: Data Structures and Program Design Using C, Scitech Pub.*
8. *Tenenbaum, A. M.: Data Structures Using C: Pearson Education.*

COURSE OUTCOMES:

The students will be able to

CO1: Design correct programs to solve problems.

CO2: Compare various programming, and apply the concept of decision structures, loops and functions.

CO3: Choose efficient data structures and apply them to solve problems.

CO4: Analyze the efficiency of programs based on time complexity.

CO5: Prove the correctness of a program using loop invariants, pre-conditions and post-conditions in programs

CO6: Design reusable ADTs.

MS4103 THEORY OF COMPUTATION CREDITS-3

UNIT - I

Fundamentals& Finite Automata:

Alphabet, Strings, Language, Operations, Mathematical proving techniques, Finite state machine, Finite automaton model, Acceptance of strings and languages, Deterministic Finite Automaton (DFA) and Non deterministic Finite Automaton (NFA), Transition diagrams and Language recognizers, Equivalence of DFA and NFA, NFA to DFA conversion, NFA with € - transitions - Significance, acceptance of languages. Equivalence between NFA with and without € -transitions

UNIT - II

Regular Expression and Languages:

Regular sets, Regular expressions, Constructing finite Automata for a given regular expression, Conversion of Finite Automata to Regular expressions, Regular grammars-right linear and left linear grammars, Equivalence between regular grammar, Regular expression and Finite State Automata, Pumping lemma of regular languages, closure properties of regular languages.

UNIT - III

Context Free Grammars and Push down Automata:

Context-Free Grammars, Leftmost and Rightmost derivations, Sentential Forms and Derivation Trees, Parsing and Membership, Parse Trees, Ambiguous Grammars, Simplification of Context-Free Grammars, Chomsky Normal Form, Greibach Normal Form, Pushdown Automata, Equivalence of PDA and Context-Free Grammars, Closure Properties of Context-Free Languages, Pumping Lemma for Context-Free Languages.

UNIT - IV

Turing Machines and other relevant Topics:
Turing Machines, Turing Machines as Language Accepters, Church-Turing hypothesis, Computable functions, recursively enumerable languages, Decidable, Undecidable and reducible problems, Efficiency of computation, Turing Machine and complexity, Language family and complexity classes, the complexity classes P and NP.

Reference Books:

1. *An Introduction to Formal Languages and Automata, 5th edition, Peter Linz, Jones & Bartlett Publishers, 2018.*
2. *Elements of the theory of computation, Lewis, 2nd edition, Harry R. and Christos H. Papadimitriou Prentice-Hall, Englewood, 1998.*
3. *Shyamalendu Kandar; Automata Theory and Formal Languages; 1st Edn.; Pearson; 2012*
4. *John E. Hopcroft & Rajeev Motwani; Introduction to Automata Theory Languages and Computation; 3rd Edn.; Pearson.*
5. *Kamala Krithivasan; Introduction to Formal Languages, Automata Theory and Computation; Pearson*
6. *Chander Kumar Nagpal; Formal Languages and Automata Theory; 1st Edn.; Oxford; 2015*
7. *Michael Sipser; Introduction to the Theory of Computation; 3rd Edn.; Cengage; 2013*
8. *Basavaraj S.Anami & Karibasappa K.G.; Formal Languages and Automata Theory; Wiley.*
9. *H S Behera, Janmenjoy Nayak & Hadibandhu Pattnayak; Formal Languages and Automata Theory; S.Chnad Publishing; 2014*
10. *Manish Kumar Jha; Automata Theory: A Step by Step Approach: S.Chand; 2015*

COURSE OUTCOMES:

The students will be able to

CO1: Apply a number of proof techniques to theorems in language design.
CO2: Have a good knowledge of formal computational models and its relationship to formal Languages.
CO3: Present the theory of finite automata, as the first step towards learning advanced topics, such as compiler design.
CO4: Design and Implementation of FA, PDA and TM for various problems.
CO5: Be able to classify languages based on their type of grammars
CO6: Understand the basic concepts of complexity theory and limits of computation.

MS4105 DISCRETE MATHEMATICS CREDITS-3

UNIT I

Sets and Proposition

Basics: Finite and Infinite Sets, Combinations of Sets, Multisets, Venn Diagrams.

Propositional Logic: Propositions and Logical Operations, Functionally complete set of connectives, Well Formed Formulas, Laws of equivalence, Normal forms, Predicate calculus, Inference Theory.

Notion of Proof: Direct and Indirect Proof, Inductive proofs.

UNIT II

Relations and Functions, Counting Techniques

Relations: Properties of Relations, Matrices of relations, Closure operations on relations, Equivalence Relations, Computer Representation of Relations, Partial Ordering Relations and Lattices, Properties of Lattices, Hasse Diagram of partially ordered set.

Functions: Introduction to functions and its types, Function for Computer Science, Discrete numeric Functions, Composition of Functions, Invertible Functions, Recursive Functions, Generating functions.

Counting- Basics of Counting Techniques, Pigeonhole Principle, Generalized Permutations and Combinations, Recurrences Relations.

UNIT III

Graph Theory- Basic Concept of Graph Theory and Terminology, representation of Graphs, Bipartite, Regular, Planar and connected graphs, reachability and connectedness.

Matrix representation of graphs, Storage representation and manipulation of graphs, Euler graphs, Hamiltonian path and circuits, graph traversals, shortest path in weighted graphs, Graph Isomorphism and Homomorphism.

Trees: Introduction, Undirected Trees, Binary search trees, Spanning trees, Minimum spanning trees, Kruskal's Algorithm, Prim's Algorithm.

UNIT IV

Algebraic Structures: Definition, Properties, Types: Semi Groups, Monoid, Groups, Abelian group, Subgroup, cyclic groups, Factor group, Permutation groups, Normal subgroup, Cosets and Lagrange's Theorem, Homomorphism and Isomorphism of Groups.

Boolean Algebra: Boolean Functions, Representing Boolean Functions, Principal of Duality, Design and Implementation of Digital Networks, Karnaugh maps.

Coding Theory: Codes and Group-codes, Error detection and correction using Group codes, Hamming Code.

Reference Books:

1. *K. H. Rosen, "Discrete Mathematics and its Applications", MGH, 8th Edition, 2021*
2. *T.Veerarajan," Discrete Mathematics ". MGH, 2012.*
3. *B. Kolman, R. C. Busby, S. Ross, "Discrete Mathematical Structures", PHI, 6th. Edition, 2010.*
4. *S. Lipschutz, Discrete Mathematics, MGH, 2nd. Edition, 2005*
5. *Richard Johnsonbough, "Discrete Mathematics", Pearson Education, 8th. Edition, 2018.*
6. *K. Viswanathan Iyer: Discrete Mathematics with Applications, 1st Edn. Cengage, 2022*
7. *Edgar G. Goodaire : Discrete Mathematics with Graph Theory : 3rd Edn. Pearson Education.*

COURSE OUTCOMES:

The students will be able to

CO1: Describe fundamental mathematical concepts and terminology.

CO2: Understand circuit design using Boolean algebra concepts.

CO3: Apply counting principles of different types of discrete structures.

CO4: Analysis of recursive definitions.

CO5: Evaluates the techniques for constructing mathematical proofs using examples.

CO6: Design solutions based on Graph Theory, Coding Theory and Group Theory.

MS4107 DATABASE MANAGEMENT SYSTEM CREDITS-3

UNIT - I

Database & Database users, Characteristic of the database, database systems, Concepts & Architecture, schemas & instances, Data independence, Database languages & interfaces. Relational Data models, Concepts & Relational database constraints, Database design using ER, EER to Relational mapping and Relational algebra.

UNIT - II

Functional Dependencies and its implication, closure rules, Normalization, Decomposition, synthesis approach, 3NF and BCNF, lossless join and dependency preserving decomposition, multi valued dependency & 4NF, Join dependency & 5NF.

UNIT - III

Basics of query processing, Processing of joins, materialized vs. pipelined processing, DB transactions, ACID properties, interleaved executions, schedules, serialisability, concept of database recovery and backup.

UNIT-IV

Concurrency control techniques, Locking and management of locks, 2PL, locking techniques deadlocks, Optimistic Concurrency control, Comparison of Concurrency control methods, XML and relational databases and big data concept.

Reference Books:

1. *R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, Pearson Education.*
2. *Silberschatz,A.; Korth, H. F.and S. Sudarshan, Database System Concepts, 7th, MGH, 2021*
3. *C. Coronel, S. Morris & P. Rob, Database Principles Fundamentals of Design Implementation and Management, 10th Edition, Cengage, 2013*
4. *Thomas Connolly & C. Begg : Database Systems : A Practical Approach to Design, Implementation and Management : 6th Edn. Pearson Education, 2019*
5. *Rajiv Chopra: Database Management Systems: A Practical Approach: 5th Edn. S. Chand, 2016*
6. *P.S. Gill : Database Management Systems : 2nd Edn. , Wiley.*

COURSE OUTCOMES:

The students will be able to

CO1: Define basic database concepts, role of a database management system including the structure and operation of the relational data model.

CO2: Compare simple and moderately advanced database queries using SQL and Relational Calculus.

CO3: Apply logical database design principles, including E-R diagrams and database normalization.

CO4: Analyze the concept of a database transaction and related database facilities, including concurrency control, journaling, backup and recovery, and data object locking and protocols.

CO5: Evaluate the performance of query processing in distributed database systems.

CO6: Design basic database storage structures & access techniques.

MS4109 OPERATING SYSTEMS CREDITS-3

UNIT-I

Introduction: Evolution of operating systems, Types of operating systems, Different views of the operating systems, Operating system concepts and structures.

Processes: The process concept, system programmer's view of processes. The operating system's view of processes, Operating system services for process management, scheduling algorithms, Performance evaluation.

UNIT-II

Inter-process Communication and Synchronization: The need for inter-process synchronization, Mutual exclusion, Semaphores, Classical problems in concurrent programming, Critical region, Monitors.

Deadlock: Deadlock criteria, prevention, avoidance, detection and recovery algorithms.

UNIT-III

Memory Management: Contiguous memory allocation, Swapping, paging and segmentation, virtual memory, Page replacement algorithms. Design issues for paging systems, Segmentation.

File Systems: File systems, Directories, File system implementation, Security & protection mechanisms.

UNIT-IV

Principles of I/O Hardware and software: I/O devices, Device controllers, Principles of I/O Software, Interrupt handlers, Device drivers, Device independent I/O software, User space I/O software.

Disks: Disk hardware, scheduling algorithms, Error handling, track-at-a-time caching, RAM Disks.

Clocks: Clock hardware, Clock software.

Terminals: Terminal hardware & software, Memory-mapped terminals, I/O Software.

Reference Books:

1. *Silberschatz& Galvin, Operating System Concepts, 9th Edition, Wiley, 2020.*
2. *D. M. Dhamdhere , Operating Systems a Concept Based Approach, 3rd Edition, MGH, 2017*
3. *P. C. Bhatt, An Introduction to Operating Systems: Concepts & Practice, 4th Edn, PHI*
4. *Andrew S Tanenbaum and Albert S Woodhull, Operating System Design & Implementation, 3rd Edition, Pearson Education, 2015.*
5. *Godbole, A.S. : Operating Systems : 3rd Edn., MGH, 2018*
6. *M.K. Singh : Operating Systems: Concept Building & Problem Solving Approach : Cengage*
7. *William Stallings : Operating Systems: 9th, Pearson Educations, 2018*

COURSE OUTCOMES:

The students will be able to

CO1: Define fundamentals of Operating System.

CO2: Compare processes scheduling algorithms.

CO3: Apply the concepts of memory management, paging and virtual memory.

CO4: Analyze and discuss the policies of synchronization.

CO5: Evaluate the uses of system call.

CO6: Develop interaction techniques among the various components of computing system.

PRACTICALS

MS4191 PROGRAMMING AND DATA STRUCTURES LAB CREDITS-2

C programming: variables and expression assignment, Loop, if-else, Case statement, break, continue,

Single & Multidimensional arrays, Functions, recursion, file handling in C, Pointers, address operator, declaring pointers and operations on pointers

Stack: Problems of stack, evaluation of Arithmetic expressions in infix, prefix, and postfix forms.

Queue: Problems on queues, circular queues, insertion and deletion on queues.

Searching and sorting algorithm: Problems on Binary Search, Quick sort, Bubble sort

L**ist:** Problems on single linked list, doubly linked list with list operations, circular list.

Trees: Creation of Binary tress, determination of depth of binary tree, counting nodes, tree traversals, BST.

Graphs: Problems on graphs, Breadth First Search, Depth First Search.

MS4195 SOFT SKILLS LAB CREDIT-1

Communication Skills: LSRW (Listening, Speaking, Reading, Writing) Basics, Pronunciation (Do's and Don'ts). Major elements in grammar (Verbs and their types, Tenses, Punctuation and sentence formation) E-mail etiquette and Report writing

Personality Development: A guide to healthy conversations, Art of Assertiveness, Emotional Intelligence and Critical, Thinking, Body Language, Grooming skills, Stress management

Presentation Skills: Elements of Effective presentation, Structure of presentation, Body language and Voice modulation Presentation tools: Applications, Audience Engagement.

Public Speaking: Speaking Basics, 7Ps of Public Speaking, Confidence Enhancement, Impression management, Feedback handling

Reference Books:

1. *John Seely, Oxford Guide to Writing and Speaking, Oxford University Press, 2005*
2. *Pillai and Fernandez, Soft Skills and employability skills, Cambridge Publication*

MS4197 DATABASE MANAGEMENT SYSTEM LAB CREDITS-2

Study features of a commercial RDBMS package such as Oracle and Structured Query Language (SQL).

Laboratory exercises should include defining schemes for the applications, creation of a database, writing SQL queries to retrieve and manipulate data from the database. Use of host language interface with embedded SQL.

YG-1081 YOGA AND HUMAN CONSCIOUSNESS CREDITS: 2

UNIT-I

Concept and significance of consciousness: Modern and ancient approach of consciousness, Types of consciousness viz., Jagrata, Svapna, Susupti, Turya, and Turiyatita.

UNIT-II

Preparatory practices: Breathing practices, Suksma vyayma (all 46 practices), and Sthoola vyayma (all 14)

UNIT-III

Dharana practices: Principles and procedure of Antaranga & Bahranga trataka, Jatru trataka & Jyoti trataka; Principles and practices of Ajappa japa, Antarmouna, Chakra meditation, Cyclic meditation, and Transcendental meditation.

UNIT-IV

Concept and practice of Dhyana: Concept of Jyoti and Bindu dhyana, principle and procedure of Vipassana meditation, Preksha meditation, Transcendental meditation, Brahma kumari Raja yoga meditation, and Yoga nidra.

Reference Books:

1. *Yogic Sukshma Vyayma by Dhirendra Brahmachari, 1st edition, MDNIY publisher, Ashoka Road, New Delhi, 1975.*
2. *Mandukya Upanishad by Swami Harsanansda, R K Mission Publication, 1st edition, Belur math, Kolkata, 2006.*

SECOND SEMESTER

MS4102 COMPUTER NETWORKS CREDITS-3

UNIT - I

Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design, Physical Layer Transmission Media, Switching methods, ISDN, Terminal Handling.

UNIT – II

Medium Access Sub Layer: Channel Allocations, LAN protocols,Overview of IEEE standards- FDDI. Data Link Layer - Elementary Data-Link Protocols, Sliding Window protocols, Error Handling.

UNIT – III

Network Layer: Point-to-Point Networks, routing, Congestion control, Internetworking-TCP / IP, IP packet, IP address, IPv4 & IPv6.

TCP/IP Protocol Stack:TCP and UDP, Routing Protocols

Transport and Session Layer: Design issues, connection management, TCP - Window Management. remote procedure call.

Presentation Layer: Design issues, Data compression techniques, cryptography.

UNIT – IV

Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, DHCP.

Reference Books:

1. *B. A. Forouzen, "Data Communication and Networking", 6th Edn., MGH, 2022*
2. *A.S. Tanenbaum, Computer Networks, 6th Edn., Pearson Education. 2022*
3. *W. Stallings, Data and Computer Communication, 8th Edition, Macmillan Press, 2017*
4. *Larry L. Peterson and Bruce S. Davie, Computer Networks: A System Approach, 5th Edition, Morgan Kaufmann Publishers, 2011*
5. *Mayank Dave: Computer Networks: 1st Edn. Cengage*
6. *Dhanashree K. Toradmalle: Computer Networks and Network Design : Wiley*

COURSE OUTCOMES:

The students will be able to
CO1: Define fundamental concepts of computer networking.
CO2: Classify the basic taxonomy and terminology of computer networking.
CO3: Apply advanced networking concepts.
CO4: Analyze specific areas of networking such as the design and maintenance of individual networks.
CO5: Evaluate routes to create interconnect of nodes.
CO6: Design and implement the protocols used in computer networks.

MS4104 DESIGN AND ANALYSIS OF ALGORITHMS CREDITS-4

UNIT-I

Growth of Functions, Asymptotic notations, Analysis of Insertion sort, Divide and Conquer technique, Recurrences, Solving Recurrences: Substitution Method, Recurrence tree, Master's theorem, Generating function, Analysis of Merge sort.

UNIT-II

Heap sort, Priority queue, Analysis of heap sort, Data structure for disjoint sets, Disjoint set operations, Greedy Technique: Huffman Codes, Knapsack problem.

UNIT-III

Dynamic programming, Evaluation of Binomial Coefficient, Matrix chain multiplication, Longest Common Subsequence (LCS), Graph Algorithms: Minimum spanning tree (Algorithm of Kruskal & Prim), Single source shortest paths (Dijkstra's Algorithm), All pairs shortest paths (Floyd-Warshall algorithm).

UNIT-IV

Concept of Backtracking, N Queen Problem, Branch and Bound, Approximation Algorithms: Polynomial Time, Polynomial-Time certification, NP-Completeness, NP Completeness and reducibility, NP-Complete problems: The circuit satisfiability problem, The clique problem, The vertex-cover problem, The subset sum problem, Algorithm for travelling-salesperson problem.

Reference Books:

1. *S. Sridhar, Design and Analysis of Algorithms, 1st Edition, Oxford, 2015.*
2. *T.H Coremen C. E. Leiserson, R. L. Rivest, Introduction to Algorithms, 3rd Edition, MIT Press*
3. *E.Horwitz, S.Sahani, Fundamentals of Computer Algorithms, 2nd Edn., Universities Press, 2008.*
4. *Michael T. Goodrich, Design and Analysis of Algorithms, 1st Edition, Wiley, 2019.*
5. *Anany Levitin : Introduction to the Design and Analysis of Algorithms; Pearson Education, 2017*

COURSE OUTCOMES:

The students will be able to

CO1: Explain different computational models, order notation and various complexity measures.

CO2: Compare the complexities of problem-solving techniques.

CO3: Apply the fundamental graph theory algorithms and to solve related problems.

CO4: Analyze efficient algorithms in common engineering design situations.

CO5: Evaluate the criteria and specifications of algorithmic design techniques.

CO6: Design approximation algorithms.

MS4106 OBJECT ORIENTED PROGRAMMING CREDITS-3

UNIT - I

OOPS Concept and Introduction to Java: OOP's concept, Programming Paradigm, Basics of Java, Data Types, Variables, Operators, Control Statements, Loops and Arrays.

Classes and Objects: Classes, Methods, Inner Classes, Packages, Strings, Inheritance & Polymorphism, Abstract class, Interfaces, Exception Handling, Java Collections.

UNIT - II

Java I/O: Input Stream, Output Stream, File Stream.

Multithreaded Programming: Multithreading concepts, Thread Life Cycle, Creating Multithreaded Application, Thread priorities, Thread synchronization.

Networking with Java: Networking basics, Sockets, port, java.net – networking classes and interfaces, Implementing TCP/IP based Server and Client, Datagrams – Datagram packet, Datagram server and client.

UNIT-III

Applets: Applet Architecture, Applet Life Cycle, adding images and sound to an applet, passing parameters to an applet, Creating Applet Application, Requesting repainting.

AWT & Event Handling: Layout Managers, Border layout, Flow layout, Grid layout, Card layout, AWT all components, Event delegation Model, Event source and handler, Event categories, Listeners, interfaces, Anonymous classes.

UNIT-IV

Swings: Model view Controller design pattern, Different layout, Menus, Dialog boxes, Text input etc.

Database Connectivity with JDBC: Java database connectivity, Types of JDBC drivers, writing first JDBC applications, Types of statement objects (Statement, Prepared Statement and Callable Statement), Types of Resultset, ResultSetmetadata, Inserting and updating records, JDBC and AWT, Connection pooling.

Reference Books:

1. *PatricNaughton, Herbert Schildt, Java 2 Complete Reference, 9th Edn., MGH, 2017*
2. *R. Nageswara Rao, Core Java: An Integrated Approach, 1st Edition, Dreamtech Press, 2016*
3. *Ivor Horton, Beginning Java, 7thEdition, Wiley, 2011*
4. *Core Java For Beginners, 3rd Edition, Vikash Publication, 2013*
5. *Jim Keogh, Complete Reference- J2EE, 1st Edition, MGH, 2017*
6. *P Radha Krishna: Object Oriented Programming through Java : Universities Press, 2016*
7. *N B Venkateswarlu & Dr. E V Prasad: Learn Object Oriented Programming Using Java: S.Chand*

COURSE OUTCOMES:

The students will be able to

CO1: Describe the differences between object-oriented programming and procedural programming.

CO2: Understand the fundamental concepts of object oriented programming.

CO3: Apply the advanced concept of object-oriented programming such as inheritance and polymorphism.

CO4: Analyze the additional features of JAVA that are not available in function oriented programming languages such as exceptional handling, Interface, etc.

CO5: Evaluate the functionalities like Multithreading and Networking with JAVA.

CO6: Develop small scale projects using AWT, swings and JDBC.

MS4108 Optimization Techniques CREDITS-3

UNIT - I

Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem – Optimal Problem formulation – Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria – Review of basic calculus concepts – Global optimality. Classical Optimization Techniques – Single Variable Optimization – Multi Variable Optimization Without Constraints- Necessary and Sufficient Conditions for Minimum/Maximum – Multi Variable Optimization With Equality Constraints Solution by Method of Lagrange Multipliers – Multi Variable Optimization With Inequality Constraints – Kuhn – Tucker Conditions.

UNIT - II

Linear programming methods for optimum design: Review of Linear programming methods for optimum design.

Unconstrained Linear Programming: One-Dimensional Minimization Methods: Classifications, Fibonacci Method and Quadratic Interpolation Method – Unconstrained Optimization Techniques – Univariate Method, Powell's Method, Steepest Descent Method, Newton’s Method.

UNIT -III

Unconstrained NonLinear Programming: Characteristics of a Constrained Problem, Classification, Basic Approach of Penalty Function Method; Basic Approaches of Interior and Exterior Penalty Function Methods, Introduction to convex Programming Problem.

Multi-objective optimization, Pareto optimization

UNIT-IV

Soft Computing Methods: Evolutionary programming methods, Introduction to Genetic Algorithms (GA), Simulated Annealing , Ant colony optimization (ACO), Tabu search ,Neural-Network based Optimization, Swarm intelligence programming methods, Partial Swarm Optimization (PSO), Teaching Learning Based Optimization (TLBO), Differential evolution (DE) algorithm, Bacterial foraging algorithm, Ant colony optimization algorithm (ACO)

Reference Books:

1. *S.S. Rao,"Engineering Optimization: Theory and Practice",5th edition, New Age International (P)Ltd.,New Delhi, 2019.*
2. *J. Arora – 'Introduction to Optimization Design', 4th edition, Elsevier Academic Press, New Delhi, 2018.*
3. *Kalyanmoy. Deb,"Optimization for Engineering Design, 2nd edition, PHI, 2012*
4. *H.A. Taha,"Operations Research: An Introduction", 10th Edition, Macmillan, New York, 2016.*
5. *Raju, N.V.S. : Optimization Methods for Engineering, PHI Lerning.*
6. *Chander Mohan & Kusum Deep : Optimization Techniques, 2ndEdn., New Age International*
7. *Manoj K. Ramteke : Optimization for Engineers : 1st Edn.; New Age Int.; 2021*
8. *KV Mital : Optimization Methods : 5th Edn.; New Age; 2020*
9. *AK Malik & sK Yadav; Optimization Techniques; 1st Edn.; Wiley; 2020*

COURSE OUTCOMES:

The students will be able to

CO1: Understanding the meaning of optimization.

CO2: Formulate fitness functions and cost functions for engineering optimization problems and specify the constraints as required.

CO3: Implement different single variable optimization algorithms including the gradient based methods.

CO4: Implement various constraint and unconstraint based optimizations.

CO5: Analyze and implement different multi variable optimization algorithms and a multi objective optimization techniques based on Parento-Fronts.

CO6: Implement Bio-inspired optimization algorithms for solving complex engineering problems.

MS4112 ARTIFICIAL INTELLIGENCE CREDITS-3

UNIT-I

Introduction: The Foundations of Artificial Intelligence, The History of Artificial Intelligence and the State of the Art.

Agents and Environments: Introduction, Types of agents, Structure of Intelligent Agents and Rational Agents Environments.

UNIT-II

Solving Problems by Searching: Problem-solving Agents, Formulating Problems, Example Problems, and Searching for solutions, Search Strategies, Avoiding Repeated States.

Uninformed Search Strategies: (BFS, DFS, DLS, IDDFS, Bidirectional Search**).**

Informed Search Methods: Best-First Search, Heuristic Functions, A* search and Iterative Improvement Algorithms.

UNIT-III

Constraint Satisfaction Problems: Constraint Satisfaction Problems; Backtracking search for CSPs; Local search for CSPs.

Adversarial Search: Games, Optimal Decisions in Games, Alpha-Beta pruning.

Agents that Reason Logically: A Knowledge-based Agent, The Wumpus World Environment, Representation, Reasoning and Logic, Propositional Logic: A very simple logic, an agent for the Wumpus World.

First-Order Logic: Syntax and Semantics, Extensions and Variations, Using First Order Logic, Logical Agents for the Wumpus World.

UNIT-IV

Neural Network: -Learning in Neural and Belief Networks, How the Brain Works, Neural Network Perceptions. Multi-layered feed forward Networks, Back Propagation algorithm, Applications of Neural Networks.

Genetic Algorithms: Introduction, encoding, fitness function, reproduction operators, genetic modelling, genetic operators, crossover, single site crossover. two-point crossover, multi point crossover, uniform crossover.

Planning: A simple planning agent form problem solving to planning, planning in situation calculus. Basic representations for planning. A partial-order planning example, A partial order planning algorithm.

Reference Books:

1. *Lavika Goel, Artificial Intelligence, Concepts and Applications, Wiley, 1st Edition,2021*
2. *S.J. Russell & P. Norvig, Artificial Intelligence: A modern Approach, Pearson, 2009.*
3. *P.H Winston, Artificial Intelligence, Addison Wesley, 2011.*
4. *Deepak Khemani, A First Course in Artificial Intelligence, MGH; 1st Edition, 2017.*
5. *Nils J. Nilsson, Artificial Intelligence: A new Synthesis –, 1stEdition, Elsevier, 1997.*
6. *A. Srinivasaraghavan & V. Joseph, Machine Learning, Wiley, 2019.*
7. *Saroj Kaushik: Artificial Intelligence: 2nd Edn.; Cengage, 2022*
8. *N.P. Padhy: Artificial Intelligence & Intelligent Systems: Oxford University Press*

COURSE OUTCOMES:

The students will be able to

CO1: Describe the key components of the artificial intelligence (AI) field

CO2: Explain search strategies and solve problems by applying a suitable search method

CO3: Apply artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning

CO4: Analyse and apply probability theorem, Bayesian networks, knowledge representation.

CO5: Describe and list the key aspects of planning in artificial intelligence

CO6: Design and implement appropriate solutions for search problems and for planning problems

PRACTICALS

MS4192 JAVA LAB CREDITS-2

Introduction: An overview of JAVA program, data types, variable and arrays, operators, control statements.

Classes& Objects: The general form of a class, declaring objects, assigning object reference variables, methods, constructors.

Inheritance: Inheritance basics, member access and inheritance, using super to call super class constructors. Creating a multilevel hierarchy, method overriding, dynamic method dispatch, using abstract classes, using final with inheritance.

Packages: Defining a package, finding packages and CLASSPATH, access protection, importing packages.

Interfaces: Defining an interface, implementing interfaces, applying interfaces, variables in interfaces, use static methods in an interface.

Exception Handling: Exception-Handling Fundamentals, Exception Types.

I/O Basics: Streams, reading console input, writing console output, reading and writing files.

Multithreaded Programming: The java thread model, creating a thread, creating multiple threads.

Applet: Applet fundamentals, the applet class, applet architecture, applet initialization and termination.

AWT: Introducing the AWT, working with windows, graphics, and text.

JDBC: Introduction to JDBC, Drivers Types, JDBC Objects, SQL query objects.

MS4194 MACHINE LEARNING LAB CREDITS-2

Introduce and implement different Supervised and Unsupervised learning technique

Optimization method implementation like Genetic Algorithm

Computational methods for Data Analysis, Non-linear Optimization, Problem-Solving by Soft Computing Techniques- Fuzzy Logic, Neural Networks

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets for real life applications.

THIRD SEMESTER

MS5101 BIG DATA ANALYTICS CREDITS-3

UNIT-I

Understanding Big Data: What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data ,credit risk management, big data and algorithmic trading, big data and HealthCare, big data in medicine, advertising and big data, big data technologies, Introduction to Hadoop, open source technologies, cloud and big data mobile business intelligence, Crowd sourcing Analytics, inter and trans firewall analytics.

UNIT-II

NoSQL Data Management: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases,materialized views, distribution models, sharing, masters slave replication, peer-peer replication, sharing and replication, consistency, relaxing consistency, version stamps, map reduce, partitioning and combining, composing map-reduce calculations.

UNIT-III

Basics of Hadoop: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop Distributed File System (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, oppression, serialization, Avro file-based data structures.

UNIT-IV

Map-reduce Applications: Map Reduce workflows, UNITtests with MR UNIT, test data and local tests –anatomy of Map Reduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, Map-reduce types, input formats, output formats.

Reference Books:

1. *Intelligent Data Analysis, M.Berthold and D.J.Hand, 2nd Edition, Springer, 2007*
2. J Moreira , Andre Carvalho , T Horvath,*A General Introduction to Data Analytics, Wiley, 2019*
3. *Jiawei Han, Micheline Kamber, Jian Pei , Data Mining Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publishers, 2011*
4. *Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.*
5. *DT Editorial Services, Big Data, Black Book, Dreamtech Press (Wiley), 2015.*
6. *Raj Kamal, Preeti Saxena : Big Data Analytics: MGH : 2019*
7. *G. Sudha Sadasivam & R. Thirumahal : Big Data Analytics: Oxford : 2020*
8. *Thomas Erl: Big Data Fundamentals: Pearson Education; 2016*

COURSE OUTCOMES:

The students will be able to

CO1: Understand the programming requirements viz., generic types and methods to perform data analysis.

CO2: Understand the existing technologies and the need of distributed files systems to analyze the big data.

CO3: To understand and analyze Map-Reduce programming model for better optimization.

CO4: Collect, manage, store, query, and analyze big data; and identify the need of interfaces to perform I/O operations in Hadoop.

CO5: Identify the need-based tools, viz., Pig and Hive and to handle.

CO6: Formulate an effective strategy to implement a successful Data analytics project.

MS5103 INFORMATION AND CYBER SECURITY CREDITS-4

UNIT - I

Introduction: Goals of Information Security (CIA), Security Services, Basic Network Security Terminology, Security Threats and Attacks.

Basic Encryption Techniques: Cryptography, Classical Methods, Substitution Ciphers, Transposition Ciphers, Cryptanalysis, Steganography.

UNIT - II

Modern Block Ciphers: Feistel Ciphers, Data Encryption Standard (DES), DES Analysis, Block Cipher Modes of Operations, Triple DES.

Stream Ciphers: A5/1, RC4.

UNIT - III

Public Key Cryptosystems: Public Key Cryptography, RSA, Elliptic Curve Cryptography.

Key Management: Key Distribution, Diffie–Hellman Key Exchange, Digital Signatures, X.509 Digital Certificate Standard**.**

UNIT - IV

Authentication: Message Digest, Secure Hash Algorithm, HMAC, Access Control-Passwords, Biometrics, Authorization- Firewalls, IDS.

Security at Network Layer: Secure Socket Layer (SSL) and Transport Layer Security (TLS), SSL vs IPSec, Kerberos, WEP.

UNIT - V

Software Flaws and Malware: Types of malware, Software-Based Attacks.

Cyber Security: Cyber Threats: - Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, Cyberspace and the Law, Penalties & Offences under the Information Technology Act, 2000, Cyber Forensics.

Reference Books:

1. *M. Stamp: Information Security: Principles and Practice,2nd Edition, Wiley*
2. *V. K. Pachghare: Cryptography and Information Security, 2nd Edition, PHI, 2015*
3. *Michael E. Whitman: Principles of Information Security, 5th Edition, Cengage, 2015*
4. *Forouzan: Cryptography & Network Security,3rd Edition, MGH*
5. *William Stallings: Cryptography and Network Security Principles and Practices, 7th Edition, Pearson Education, 2017*
6. *Mark Rhodes-Ousley: Information Security: The Complete Reference,2nd Edition, MGH; 2013*
7. *Atul Kahate: Cryptography And Network Security: 4th Edn.; MGH; 2019*
8. *Bernard L. Menezes; Ravinder Kumar : Cryptography, Network Security, and Cyber Laws; Cengage; 2018*

COURSE OUTCOMES:

The students will be able to

CO1: Evaluate the security threats in modern computer era.

CO2: Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography.

CO3: Define and identify firewall and network filtering.

CO4: List and recognize various VPN.

CO5: Identify different Software Flaws and Malwares.

CO6: Distinguish various ethical hacking and testing procedures.

MS5105 CLOUD COMPUTING CREDITS-3

UNIT-I

Introduction to Cloud Computing: Cloud Computing in a Nutshell, System Models for Distributed and Cloud Computing, Roots of Cloud Computing, Grid and Cloud, Layers and Types of Clouds, Desired Features of a Cloud, Basic Principles of Cloud Computing, Challenges and Risks, Service Models.

UNIT-II

Virtualization concepts: Virtual Machines and Virtualization of Clusters and Data Centers, Levels of Virtualization, Virtualization Structures / tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization Data-Center Automation.

UNIT-III

Cloud computing architectures over Virtualized Data Centers: Data–Center design and Interconnection networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms,

Inter-cloud Resource Management. Cloud Security and Trust Management, data Security in the Cloud: An Introduction to the Idea of Data Security, The Current State of Data Security in the cloud.

UNIT-IV

Common Standards in Cloud Computing: The Open Cloud Consortium, the Distributed Management Task Force, Standards for Application Developers, Standards for Messaging. Internet Messaging Access Protocol (IMAP), Standards for Security, Examples of End-User Access to Cloud Computing.

Reference Books:

1. *Raj KumarBuyya, James Broberg and Andrzej Goscinski , Cloud Computing Principles and Paradigms, 1st Edition, Wiley Publication, 2011*
2. *Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Cloud Computing for Dummies, Wiley Publication, 2009*
3. *Divyakant Agrawal, K. G. SelcukCandan, Wen-Syan Li (Eds.), New frontiers in information and software as a service, Springer Proceedings, 2011*
4. *K. Jayaswal, Cloud Computing Black Book, Dreamtech Press (Wiley), 2014.*
5. *Raj Kumar Buyya, Christian Vecchiola, S. Thamarai Selvi: Mastering Cloud Computing; MGH*
6. *Arshdeep Bahga and Vijay Madisetti: Cloud Computing: A Hands-on Approach; Universities Press.*
7. *Thomas Erl; Cloud Computing Design Patterns; 1st Edn.; Pearson Education; 2016*
8. *Shailendra Singh: Cloud Computing : Oxford University Press; 2018*

COURSE OUTCOMES:

The students will be able to

CO1: Elaborating the basic concepts of cloud computing and defining the basic terms.

CO2: Understanding the various cloud implementations and migration techniques.

CO3: To define the various industrial applications of cloud virtualization.

CO4: In depth learning of security challenges and preventive measures in cloud computing.

CO5: To Illustrate Virtualization for Data-Center Automation.

CO6: Practical implementation of cloud computing and live case studies.

PRACTICALS

MS5191 DATA ANALYTICS LAB CREDITS-2

The big data technology landscape: NoSQL-Types of NoSQL databases-Why NoSQL-Advantages of NoSQL- What we miss with NoSQL?- NoSQL Vendors SQL Vs. NoSQL- NewSQL - Comparison of SQL, NoSQL and NewSQL.

Hadoop: Features of Hadoop- Key advantages of Hadoop- Versions of Hadoop-Hadoop 1.0
Hadoop 2.0- Overview of Hadoop Ecosystems- Hadoop Vs. SQL- Integrated Hadoop systems offered by leading market vendors-Cloud based Hadoop solutions.

Introducing Hadoop: Why not RDBMS-Distributed Computing Challenges.

Hadoop Overview: Hadoop Components-High Level Architecture of Hadoop.
Hadoop Distributed File System: HDFS Architecture-Daemons Related to HDFS- Working with HDFS Command-Special Features of Hadoop.

Processing Data With Hadoop: Introduction-How Map Reduce Works-Map Reduce Example- Word Count Example using Java.

FOURTH SEMESTER

MS5102 SOFT COMPUTING CREDITS-3

UNIT - I

Fuzzy logic: Fuzzy set theory: crisp sets, fuzzy sets, crisp relations, fuzzy relations, Fuzzy Systems: Crisp logic predicate logic, fuzzy logic, Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations, fuzzy If – Then rules, fuzzy Rule based system, Defuzzification

UNIT - II

Neural Networks: Supervised Learning Neural Networks, Perceptron, Adaline, Back propagation MultilayerPerceptron, Radial Basis Function Networks, Unsupervised Learning Neural Networks, Competitive Learning Networks, KohonenSelfOrganizing Networks, Learning Vector Quantization, Hebbian Learning, Hop-field networks.

UNIT – III

Optimization: Derivative-based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search

Genetic Algorithms: Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction. Genetic Modeling: cross cover, inversion and deletion, Mutation operator, Bit-wise operators, Bitwise operators used in GA. Convergence of Genetic algorithm.

UNIT - IV

Hybrid Systems: Hybrid system, neural Networks, fuzzy logic and Genetic algorithms hybrids. Genetic Algorithm based Back propagation Networks: GA based weight determination applications: Fuzzy Back Propagation Networks.

Reference Books:

1. *S. Rajasekaran, G.A. VijayalakshmiPai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications; PHI Learning.*
2. *S N Sivanandam Principles Of Soft Computing, 2nd Edition, John Wiley, 2011.*
3. *Davis E.Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y.,1989*
4. *J.S.R.Jang, C.T.Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, , Pearson Education, 2015*
5. *N.P. Padhy & S. P. Simon; Soft Computing with MATLAB Programming; Oxford University*

COURSE OUTCOMES:

The students will be able to

CO1: Develop intelligent systems leveraging the paradigm of soft computing techniques.

CO2: Implement, evaluate and compare solutions by various soft computing approaches for finding the optimal solutions.

CO3: Recognize the feasibility of applying a soft computing methodology for a particular problem

CO4: Design the methodology to solve optimization problems using fuzzy logic, genetic algorithms and neural networks.

CO5: Design hybrid system to revise the principles of soft computing in various applications

CO6: Practical implementation of soft computing and live case studies.

ELECTIVE-I

MS5123 INTERNET OF THINGS CREDITS-3

UNIT - I

Introduction to Internet of Things:Definition & Characteristics of IoT, Physical Design of IoT, Things, Protocols, Logical Design of IoT, Functional Blocks, Communication Models, Communication APIs.
IoT Enabling Technologies: WSN, Cloud Computing, Big Data Analytics, Embedded Systems, IoT Levels (1 to 6) & Deployment Templates.

UNIT - II

Prototyping: Thinking About Prototyping: Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source, Tapping into the Community. Prototyping Embedded Devices: Electronics, Embedded Computing Basics, Developing on the Arduino, Raspberry Pi, Beaglebone Black, Electric Imp, Mobile Phone and Tablets, Plug Computing: Always-on Internet of Things. Prototyping the Physical Design: Preparation, Sketch, Iterate, and Explore, Non-digital Methods, Laser Cutting, 3D Printing, CNC Milling, Repurposing/Recycling. Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions and other Protocols.

UNIT – III

Domain Specific IoTs: Home Automation, Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Smart Cities: Parking, Lighting, Smart Roads. Structural Health Monitoring, Surveillance, Emergency Response. Environment: Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection. Energy: Smart Grids, Renewable Energy Systems. Retail: Inventory Management, Smart Payments, Smart Vending Machines. Logistics: Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring, Remote Vehicle Diagnostics. Agriculture: Smart Irrigation, Green House Control. Industry: Machine Diagnosis & Prognosis, Indoor Air Quality Monitoring, Health & Lifestyle Health & Fitness Monitoring, Wearable Electronics.

UNIT - IV

IoT and M2M: Introduction, Difference between IoT and M2M. SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization. DEVELOPING INTERNET OF THINGS: IoT Platforms Design Methodology, Purpose & Requirements Specification, Process Specification, Domain Model, Information Model, Service Specifications, Functional View, Operational View, Specification, Device & Component Integration, Application Development.

ReferenceBooks:

1. *Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2015*
2. *Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.*
3. *Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting everything", 1st Edition, Apress Publications, 2013.*
4. *Raj Kamal; Internet of Things; 2nd Edn.; MGH; 2022*
5. *Rahul Dubey; An Introduction to Internet of Things; 1st Edn.; Cengage; 2019*
6. *Mayur Ramgir; Internet of Things; 1st; Pearson; 2020*
7. *Wiley Editorial; Internet of Things: Concepts and Applications; Wiley; 2019*
8. *Dr Surya Durbha & Dr Jyoti Joglekar; Internet of Things; 1st Edn.; Oxford; 2021*

COURSE OUTCOMES:

After successful completion of this course, student will be able to

CO1: Understand general concepts of Internet of Things (IoT) (Understand)

CO2: Recognize various devices, sensors and applications (Knowledge)

CO3: Apply design concept to IoT solutions (Apply)

CO4: Analyze various M2M and IoT architectures (Analyze)

CO5: Evaluate design issues in IoT applications (Evaluate)

CO6: Create IoT solutions using sensors, actuators and Devices (Create)

MS5125 WIRELESS SENSOR NETWORK CREDITS-3

UNIT-I

Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

UNIT II

Adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

UNIT III

MAC Protocols: Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

UNIT IV

Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols. QoS and Energy Management: Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes

ReferenceBooks:

1. *C. Siva Ram Murthy, B.S. Manoj, Ad Hoc Wireless Networks: Architecture and Protocols, PHI*
2. *Kazem Sohraby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks Technology, Protocols, and Applications, John Wiley & Sons, 2007.*
3. *Ian F. Akyildiz and Mehmet Can Vu, Wireless Sensor Networks -John Wiley and Sons Ltd, Publication, 2010.*
4. *Jun Zhny and Abbos Jama Lipcar, Wireless Sensor Network - a networking perspective ,Wiley 2009.*

5. *C. Raghavendram, K Sivalingam and T. Znati, Wireless Sensor Network, Springer, 2005.*
6. *Clint Smith, Daniel Collins; Wireless Networks; 3rd Edn.; MGH; 2014*
7. *Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri; Wireless and Mobile Networks, Concepts and Protocols, 2nd Edn. ; Wiley; 2020*
8. *Upena Dalal; Wireless Communication and Networks; 1st Edn.; Oxford; 2014*
9. *C.K. Toh.; Ad Hoc Wireless Networks: Architecture and Protocols; 1st Edn.; Pearson; 2016*

COURSE OUTCOMES:

After successful completion of this course, the students will be able to demonstrate the ability to –

CO1: Analyze the architecture of wireless sensor networks and the factors influencing WSN architecture design.

CO2: Analyze the physical and MAC Layer issues in WSN.

CO3: Understand the basic principles of Routing Mechanisms in WSN.

CO4: Learn the localization and time synchronization problems with reference to WSN.

CO5: Evaluate the performance of protocols for power consumption, scalability and latency parameters.

CO6: Evaluate the congestion detection and avoidance, reliability and control packet overhead parameters.

MS5129 MANAGEMENT SUPPORT SYSTEM CREDITS-3

UNIT-I

An Overview: Introduction of Management Support Systems, Business Intelligence, Analytics and Decision support, Foundations and Technology for Decision Making, Descriptive Analytics.

UNIT-II

Descriptive Analytics: Data Warehousing, Business Reporting, Visual Analytics, Business Performance Management, Geographic Information systems.

UNIT-III

Predictive Analytics: Data Mining, Techniques for Predictive Modelling, Text Analytics, Text Mining and Sentiment Analysis, Web Analytics, Web Mining and Social Analytics.

UNIT-IV

Prescriptive Analytics: Model-Based Decision Making, Modelling and Analysis, Automated Decision Systems and Expert Systems, knowledge management and Collaborative Systems.

Reference Books:

1. *Ramesh Sharda, DursunDelen, EfraimTurban: Business Intelligence and Analytics: Systems for Decision Support,Tenth Edition, Pearson education, 2018*

2. *Efraim Turban, Jay E. Aronson, Ting-Peng Liang: Decision Support Systems and Intelligent Systems, 7th Edition,Pearson,2005*
3. *Efrem G Mallach: Decision Support systems and Data warehouse Systems,Second Edition, McGraw Hill,2002*
4. *Gregory S. Parnell, Patrick J. Driscoll, Dale L. Henderson: Decision Making in Systems Engineering and Management, 2nd Edition, Willy,2010*
5. *Ciara Heavin, Daniel J. Powe: Decision Support, Analytics, and Business Intelligence, Business Expert, Third Edition,2017*
6. *S. Christian Albright; Business Analytics: Data Analysis and Decision Making; Cengage; 2020*

COURSE OUTCOMES:

The students will be able to

CO1: Identify the guidelines for designing a management support system and phases of the decision-making process in a typical organization and the types of decisions that are made.

CO2: Understand the decision support system.

CO3: Apply geographic information system to design infrastructure solutions for organizations.

CO4: Analyze how enterprise systems and industrial networks create new efficiencies for businesses and evaluate the benefits and limitations of enterprise systems and industrial networks.

CO5: Evaluate decision support tools that can aid decision making and apply system development methodology to develop a decision support system.

CO6: Develop a functional prototype of a decision support system for a given case.

MS5131 COMPILER DESIGN CREDITS-3

UNIT - I

Introduction to Compilers: Structure of a compiler, Lexical Analysis, Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, Lex, Finite Automata, Regular Expressions to Automata, Minimizing DFA.

UNIT - II

Syntax Analysis: Role of Parser, Grammars, Error Handling, Context-free grammars, Writing a grammar, Top Down Parsing, General Strategies Recursive Descent Parser Predictive Parser-LL(1), Parser-Shift Reduce Parser, LR Parser, LR (0), Item Construction of SLR Parsing Table, Introduction to LALR Parser, Error Handling and Recovery in Syntax Analyzer, YACC.

UNIT - III

Intermediate Code Generation: Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

UNIT - IV

Run-Time Environment and Code Generation: Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management, Issues in Code Generation, Design of a simple Code Generator.

Code Optimization: Principal Sources of Optimization, Peep-hole optimization, DAG- Optimization of Basic Blocks, Global Data Flow Analysis, Efficient Data Flow Algorithm.

Reference Books:

1. *Alfred Aho, Jeffry O. Ullman, "Compilers: Principles Techniques and Tool", 2nd Edition, Pearson, 2013.*
2. *K. C. Louden, "Compiler Construction- Principles and Practice", Thomson, 2003.*
3. *V. Raghavan, Principles of Compiler Design, Mc-Graw Hill, 2010.*
4. *Allen I. Holub "Compiler Design in C", Prentice Hall of India, 2006.*
5. *C. N. Fischer and R. J. LeBlanc, "Crafting a compiler with C", 2nd Edition Benjamin Cummings, 2008.*
6. *J.P. Bennet, "Introduction to Compiler Techniques", 2nd Edition, McGraw-Hill, 2003.*
7. *ITL Education; Express Learning - Principles of Compiler Design; Pearson*

COURSE OUTCOMES:

The students will be able to

CO1: Understanding of how the different phases of compiler work.

CO2: Study of lexical analysis, and various parsing techniques.

CO3: Understand the concept of intermediate code generation technique.

CO4: Analyze code optimization technique and fundamental of runtime environment.

CO5: Illustrate the concept of storage management.

CO6: Design and implement a simple compiler for a hypothetical machine using syntax directed translation.

MS5127 MOBILE COMPUTING CREDITS-3

UNIT-I

Introduction to Mobile Communications and Computing: Applications of Mobile Computing, Generations of Mobile Communication Technologies.

(Wireless) Medium Access Control: Motivation for a specialized MAC (Hidden and Exposed terminals, Near and Far terminals), SDMA, FDMA, TDMA, CDMA. Spreading Techniques.

UNIT-II

Cellular Systems: GSM, Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security and new data services, General Packet Radio Service (GPRS), EDGE, Universal Mobile Telecommunication System (UMTS). Next Generation Networks – Orthogonal Frequency Division Multiplexing (OFDM), LTE – Architecture & Interface – LTE radio planning, 5G Architecture, MIMO Satellite Communications Systems.

UNIT-III

Wireless LAN: IEEE 802.11 - Architecture – Services – MAC – Physical layer – IEEE 802.11a - 802.11b/g/n - 802.11AC/AD/AX standards – HIPERLAN – Bluetooth, ZigBee, RFID.

Mobile Network Layer: Mobile IP -Goals, assumptions, Entities and terminology, IP packet delivery, Agent Advertisement and Discovery, Registration, Tunnelling and Encapsulation.

Mobile Ad hoc Networks (MANETs): Properties of a MANET, Routing and various routing algorithms, Dynamic Source Routing (DSR), Vehicular Ad Hoc networks (VANET) – MANET Vs VANET.

UNIT-IV

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/ fast recovery, Transmission /time-out freezing, Selective Retransmission, Transaction oriented TCP.

Protocols and Tools: Wireless Application Protocol-WAP Architecture, Mobile Device Operating Systems: iOS, Android, BlackBerry, and Security.

Reference Books:

1. *Jochen Schiller, Mobile Communications, Pearson Education; Second edition, 2014*
2. *UpenaDalal, Wireless communication & networks, Oxford University Press, 2014*
3. *Kumkum Garg, Mobile Computing, Pearson Education India, 2010*
4. *Gottapu Sasibhushana Rao, Cellular Mobile Communication, Pearson Education India, 2012*
5. *Reza Behravanfar, Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Cambridge University Press, 2004*
6. *Uwe Hansmann, LotharMerk, Martin S, Nicklous, Thomas Stober, Principles of Mobile Computing, 2nd Edition, Springer, 2006*

COURSE OUTCOMES:

The students will be able to

CO1: Identify the limitations of fixed networks.

CO2: Understand the network infrastructure requirements to support mobile devices and users.

CO3: Relate the different wireless technologies such as CDMA, GSM, GPRS, LTE, etc.

CO4: Compare the protocols and architectures employed in wireless local area networks and cellular networks.

CO5: Evaluate the techniques to design and develop a simple mobile application for smaller devices.

CO6: Design solutions using mobile computing techniques.

ELECTIVE – II

MS5122 DATA MINING CREDITS-3

UNIT - I

Introduction to Data Mining: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data

Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT - II

Data Warehouse and OLAP Technology for Data Mining: Data Warehouse,Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse implementation, Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization, Efficient Methods for Data Cube Computation.

Mining Association Rules: Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based aassociation Mining.

UNIT -III

Classification and Prediction: Issues Regarding Classification and Prediction, Classification

by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods.

UNIT-IV

Cluster Analysis: Introduction, Types of Data in Cluster Analysis, A Categorization of Major

Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, and Outlier Analysis.

Reference Books:

1. *J. Han and M. Kamber. Data Mining: Concepts and Techniques, 3rd Edition Morgan Kaufman. 2012.*
2. *M. H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson, 2001.*
3. *Hongbo Du; Data Mining Techniques and Applications : An Introduction; Cengage*
4. *Daniel T. Larose & Wali ; Data Mining and Predictive Analytics; 2nd Edn.; Wiley*
5. *Vikram Pudi & P. Radha Krishna; Data Mining; 1st Edn.; Oxford; 2009*
6. *Soman, K.P.; Diwakar Shyam; Data Mining: Theory and Practice; PHI*
7. *Pang-Ning Tan; Introduction to Data Mining; 2nd Edn.; Pearosn; 2021*

COURSE OUTCOMES:

The students will be able to

CO1: Fundamentals of data mining Functionalities, Classification, major issues in Data Mining.
CO2: Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment.
CO3: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization.
CO4: Mining Frequent Patterns, Associations and Correlations
CO5: Different Classification Methods and evaluating the accuracy of a Classifier or a Predictor
CO6: Major Clustering Methods, Clustering High-Dimensional Data and Outlier Analysis

MS5124 COMPUTER GRAPHICS CREDITS-3

UNIT-I

Introduction to Computer Graphics: Image Processing and their applications, Raster-Scan System, Random-Scan Systems. Graphics Primitives: Points and Lines, Line-Drawing Algorithms: DDA and Bresenham's Line Algorithm. Circle-Generating Algorithms: Midpoint Circle Algorithm, Bresenham's Circle Algorithm. Ellipse-Generating Algorithm: Midpoint Ellipse Algorithm. Region Filling Algorithms: Seed Fill: Boundary-Fill Algorithm, Flood-fill Algorithm, Scan-Line Polygon Fill Algorithm.

UNIT-II

Two-Dimensional Geometric Transformations: Translation, Rotation, Scaling, Matrix Representations and Homogeneous Coordinates, Composite Transformations, Inverse transformations, General Pivot-Point Rotation, General Fixed-Point Scaling, General Composite Transformations. Other Transformations: Reflection, Shear.

Two-Dimensional Viewing and Clipping: The Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to viewport Coordinate transformation, Clipping Operations: Point Clipping, Line Clipping: Cohen-Sutherland Line Clipping, Liang-Barsky Line Clipping. Polygon Clipping: Sutherland-Hodgeman Polygon Clipping.

UNIT-III

Three-Dimensional Concepts and Object Representation: Three-Dimensional Transformations: Translation, Rotation, Scaling and their Matrix Representations. Three-Dimensional Display Methods: Parallel Projection, Perspective Projection and their types. Polygon surfaces, quadric surfaces.

Curves and Surfaces: Parametric representation of curves: Bezier curves, B-spline curves. Parametric representation of surfaces; Interpolation method.

Basic Illumination models, polygon rendering methods. Basic Models, Displaying Light Intensities, halftone patterns and Dithering Techniques. Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area subdivision and octree methods. Rendering: Polygon Rendering Methods, Gouraud shading and Phong Shading.

UNIT-IV

Intuitive colour concepts: RGB, YIQ, CMY, HSV and HLS colour model, Colour selection. Design of Animation Sequence, general computer animation functions, Raster Animation, computer animation languages, key frame systems, motion specifications.

Reference Books:

1. *D. Hearn, M.P. Baker, Computer Graphics C Version, 4th Edition, Pearson Education, 2013*
2. *Hearn & Baker, Computer Graphics with OpenGL, 4thEdition, Pearson Education, 2014*
3. *Rajesh K. Maurya, Computer Graphics with Virtual Reality Systems, Wiley; Second edition, 2014*

4. *J.D.Foley, V.Dam, S.K.Feiner, J.F.Huges - Computer Graphics Principles Practice, 2nd Edition, Pearson Education, 2002*
5. *D. Rogers, Mathematical Elements of Computer Graphics, 2nd Edition, McGraw Hill Education, 2017*
6. *John F Hughes; Computer Graphics: Principles and Practice; 3rd Edn., Pearson; 2019*
7. *Samit Bhattacharya; Computer Graphics; 1st Edn., Oxford Universities Press; 2015*

COURSE OUTCOMES:

The students will be able to

CO1: Explain the core concepts of computer graphics.

CO2: Understand a typical graphics pipeline.

CO3: Apply various algorithms to scan convert the basic geometrical primitives, transformations, area filling, clipping.

CO4: Analyze the importance of viewing and projections in both 2D and 3D.

CO5: Evaluate the various factors of color and shading.

CO6: Design animations using related technologies.

MS5126 BLOCK CHAIN ARCHITECTURE CREDITS-3

UNIT-I

Introduction to Blockchain: Blockchain History, Digital Trust, Decentralization- Digital Money to Distributed Ledger Technology, Decentralized Economy, Design Primitives: Protocols, Security, Consensus.

Types of Blockchain- Permissionsvs Permission-less Blockchain and Privacy, Cryptography and Crypto PrimitivesHash-Signature-PKI, Cryptocurrency and its requirements.Bitcoin/Ethereum Basics, Double Spending, Wallet.

UNIT-II

Consensus: Overview of Blockchain Technology, Lifecycle of Blockchain- Transactions, Blocks, Hashes, Digital Signature, Consensus, Verify and confirm Blocks/Transactions, Smart Contract, Consensus Mechanisms- Proof of Work, Proof of Stake, Proof of Burn, Proof of Authority and Proof of Elapsed Time, Role of the Miners, Requirements for the Consensus Protocols, Scalability aspects of Blockchain.

UNIT-III

Blockchain Architecture: Markle Root Tree, Blockchain Platform, Mining and simulating Blockchain, Competitive Mining, Incentives- mining and transaction fee, CPU and Energy Considerations,

Features of Hyperledger, Hyperledger Model: Decomposing the consensus process, Hyperledger components, IOTA, EOS, Multichain, CORDA and SOLIDITY.

UNIT-IV

Blockchain Use Cases: – Design and Implementation of a Distributed Application (DAPP), Auto execution of contracts.

Blockchain in Finance: Settlements, KYC, Capital Markets and Insurance, Blockchain in trade/supply-chain: Provenance of goods, visibility, Invoice Management, Blockchain in Government: Digital Identity, Land Records, Public Distribution System and Social Welfare Systems, Blockchain Security, AI-Blockchain-and-Big Data.

Reference Books:

1. *Imran Bashir, Mastering Blockchain, 2nd Edition, Packt Publishing, 2018.*
2. *Paul Laurence, Blockchain: Step-By- Step Guide to Understanding and Implementing Blockchain Technology, 2018.*
3. *Melanie Swan, Blockchain – Blueprint for a new Economy, OReilly, 2018.*
4. *Alan Wright, Blockchain: Uncovering Blockchain Technology, Cryptocurrencies, Bitcoin and the Future of Money: Blockchain and Cryptocurrency Exposed,2017.*
5. *A. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly*
6. *Kevin Werbach, The Blockchain and the new architecture of Trust, MIT Press, 2018.*
7. *Joseph J. Bambara and Paul R. Allen, Blockchain – A practical guide to developing business, law, and technology solutions, McGraw Hill, 2018.*
8. *Arjuna Sky Kok, Hands-On Blockchain for Python Developers: Gain blockchain programming skills to build decentralized applications using Python, Pockt, 2019*
9. *Chandramouli Subramanian; Blockchain Technology; Universities Press; 2020*
10. *Kumar Saurabh, Ashutosh Saxena; Blockchain Technology: Concepts and Applications; Wiley*

COURSE OUTCOMES:

The students will be able to

CO1: Familiarized with Blockchain Terminology.

CO2: Understand the concept of Blockchain, Bitcoin.

CO3: Understand de-centralization.

CO4: Gain knowledge about the domain of blockchain in real time.

CO5: Basic knowledge of Bitcoin, Ethereum and Hyperledger fabric.

CO6: Design and Implementation of case study based Distributed Applications.

MS5128 FORMAL LANGUAGE AND AUTOMATA THEORY CREDITS-3

UNIT-I

Automata and Language Theory: Overview of Theoretical Computer Science (including computationally intractable problems) , Introduction to System software including various phases / Modules in the design of a typical compiler , Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA),statement of Kleen's Theorem, Regular Expressions, Equivalence of DFAs, NFAs.

UNIT-II

Regular Expressions, Closure properties of Regular Language, Non-Regular Languages, Pumping Lemma, Use of Regular expressions in the Design of scanner (lexical analyzer)

UNIT-III

Context Free Languages: Context Free Grammar (CFG), Parse Trees, Push Down Automata (deterministic and nondeterministic) (PDA), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma.

UNIT-IV

Turing Machines and Computability Theory: Definition of Turing Machine, Extensions of Turing machines, Non – deterministic Turing machines, Church – Turing Thesis, Decidability, Halting Problem.

Reference Books:

1. *M. Sipser, ―Introduction to the Theory of Computation, 3rd edition, Cengage Publication, 2014.*
2. *J. Hopcroft, R. Motwani, and J. Ullman, ―Introduction to Automata Theory, Language and Computation,3rd edition, Pearson Publication, 2008.*
3. *H.S. Behera, J. Nayak, H. Pattanayak, ‖Formal Languages and Automata Theory" 1st edition, Vikas Publication, 2014.*
4. *Shivam Saxena; Automata Theory, Languages of Machines and Computability; Wiley; 2020*
5. *Basavaraj S.Anami, Karibasappa K.G.; Formal Languages and Automata Theory; Wiley*
6. *Chander Kumar Nagpal; Formal Languages and Automata Theory; Oxford; 2011*
7. *Shyamalendu Kandar; Express Learning – Automata Theory and Formal Languages, 1/e; Pearson; 2012*

COURSE OUTCOME:

CO1: Express the overview of the theoretical foundation of computer science from the perspective of formal languages.
CO2: Demonstrate regular language and expression in the context of computation and Compiler. Define and design the deterministic and nondeterministic machines.
CO3: Demonstrate and design push down automata and context free language. .
CO4: Define the concept of Turing machine and able to design Turing machine for various languages.
CO5: Analyze the complexity classes, decidability, enumerable language, post Correspondence problem and associated concepts.

MS5132 GEOGRAPHIC INFORMATION SYSTEM CREDITS-3

UNIT I

Fundamentals of GIS: Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of GIS – Hardware, Software, Data, People, Methods – Proprietary and open source GIS Software – ArcGIS and Quantum GIS, Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT II

Spatial Data Models: Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards – Spatial Database-Spatial Data Infrastructure-Data Quality, Data interoperability.

UNIT III

Data Input and Topology: Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser –Topology - Adjacency, connectivity, and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT IV

Data Analysis and Web GIS: Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation. Introduction to Web GIS, OGC Standards and services, Geospatial SOA, Introduction to Spatial Cloud Computing. **GIS Applications:** GIS Applicant - Natural Resource Management – Vehicle tracking and fleet management- Disaster Management System-Engineering - Navigation - Marketing and Business applications - Case studies.

Reference Books:

1. *Chang, Kang-Tsung. Introduction to geographic information systems.: McGraw-Hill, 9th Edition, 2019.*
2. *Ian, Heywood. An introduction to geographical information systems. 2nd edition, Pearson Education India, 2010.*
3. *Yang, Chaowei, and Qunying Huang." Spatial cloud computing: a practical approach". 2nd edition, CRC Press, 2013.*
4. *Basudeb Bhatta; Remote Sensing and GIS; 1st Edn.; Oxford; 2020*

COURSE OUTCOMES:

CO1: Understand the foundations of geographic information systems (GIS).

CO2: Illustrate the concept and types of geospatial data models.

CO3: Acquire knowledge of data intake and topology.

CO4: Learn about geospatial data management functions and geospatial data output.

CO5: Process spatial and attribute data and prepare thematic maps.

CO6: Develop and find solutions to geographical challenges.

ELECTIVE – III

MS5142 NATURAL LANGUAGE PROCESSING CREDITS-3

UNIT - I

Introduction: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

UNIT - II

Word Level Analysis : Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT - III

Syntactic Analysis : Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT - IV

Semantics and Pragmatics: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

Reference Books:

1. *Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, 2 edition, Pearson, 2013.*
2. *Steven Bird , Ewan Klein, Natural Language Processing with Python: Analysing Text with the Natural Language Toolkit, 1st edition, SPD, 2011.*
3. *Manning, C. D. and H. Schutze, Foundations of Statistical Natural Language Processing, The MIT Press, 1999*
4. *Allen, J., Benjamin's, Natural Language Understanding, Cummings Publishing Company Inc, 1994*
5. *U.S. Tiwary & Tanveer Siddiqui: Natural Language Processing & Information Retrieval; Oxford University Press.*
6. *Ela Kumar: Natural Language Processing; Wiley*

COURSE OUTCOMES:

The students will be able to

CO1: Demonstrate a given text with basic Language features.

CO2: Explain a rule-based system to tackle morphology/syntax of a language.

CO3: Distinguish different Models & Tagging.

CO4: Design a tag set to be used for statistical processing for real-time applications.

CO5: Compare and contrast the use of different statistical approaches for different types of NLP applications.

CO6: Design an innovative application using NLP components.

MS5144 ORGANIZATIONAL BEHAVIOUR CREDITS-3

Unit I:

Meaning, Fundamental concepts, Definition, Approaches to OB, Characteristics and limitations of OB, Challenges and Opportunities of OB, Models of OB.Personality: Definition, Features, Big five model, MBTI, Johari Window, Managerial Implications of Personality.Perceptions and Attributions: Definition, Features, factors affecting perception, Process. Attribution, perceptual and attribution errors, Managerial Implications of Perception.

Unit II:

Learning: Definition, Features, Classical and operant conditioning, social learning theory, Behavioral modification. Attitude: Definition, Features, ABC model of Attitude, Managerial Implications of Attitude. Motivation: Concept, Definition, Features, Types of Motivation, Process, Managerial Implications of Motivation.Leadership: Concept, Definition, Leadership Styles, Transactional and Transformational Leadership, Leadership development.

Unit III

Groups and Teams: Definition, Features, Group development stages, Group vs. Teams, Managing and developing effective teams.Conflict Management: Definition, Features, Types of Conflict, Conflict Resolution Strategies, Relationship between Conflict and Performance.

Unit IV

Organizational Culture: Elements and dimensions of organizational culture, Importance of organizational culture in shaping the behaviour of people.Organizational Change: Understanding the issues and managing change, Approaches to organizational change.

ReferenceBooks:

1. *Stephen P. Robbins, Essentials of Organizational Behavior, 14th.Edition; Pearson, 2022.*
2. *Uma Sekharan, Organizational Behavior, 2nd. Edition, MGH, 2004.*
3. *Pareek. U. Understanding Organizational Behavior (2nd ed.). Oxford University Press, 2010*
4. *Schermerhorn, J. R., Osborn, R.N., Hunt, M.U.J . Organizational Behavior, 12th ed. Wiley. 2016*
5. *Steven McShane, Mary Ann Von Glinow, Himanshu Rai; Organizational Behavior; 9th; MGH; 2022*
6. *Ricky W. Griffin; Jean M. Phillips; Organizational Behavior : Managing People and Organizations; 13th Edn.; Cengage; 2020*
7. *Preetam Khandelwal; James Campbell Quick; Organization Behavior: Cengage; 2013*

COURSE OUTCOMES:

CO1: Demonstrate the applicability of the concept of organizational behaviour to understand the behaviour of people in the organization.

CO2: Demonstrate the applicability of analyzing the complexities associated with management of individual behaviour in the organization.

CO3: Analyze the complexities associated with management of the group behaviour in the organization.

CO4: Demonstrate how the organizational behaviour can integrate in understanding the motivation (why) behind behaviour of people in the organization.

CO5: Human aspects are critical in each functional aspects of management

CO6: Describe how people behave under different conditions and understand why people behave as they do.

MS5146 GRAPH ALGORITHM CREDITS-3

UNIT - I

Introduction to Graphs: Definition and basic concepts, Efficient representations of Graphs, graphs as models, matrices and isomorphism, decomposition and special graphs, Paths, Cycles and Trails, Bipartite graphs, Eulerian circuit, Vertex degrees and counting, directed graphs

UNIT - II

Graph Searching: DFS and BFS; Application of Graph Searching: finding connected components, bi-connected components, testing for bipartite graphs, finding cycle in graph.**Trees:** Different MST algorithms, enumeration of all spanning trees of a graph; Paths and Distance in Graphs: Single source shortest path problem, All pairs shortest path problem, center and median of a graph, activity digraph and critical path;

UNIT -III

Hamiltonian Graphs: sufficient conditions for Hamiltonian graphs, traveling Salesman problem; Eulerian Graphs: characterization of Eulerian graphs, construction of Eulerian tour, The Chinese Postman problem; Planar Graphs: properties of planar graphs, a planarity testing algorithms

UNIT-IV

Graph Coloring: vertex coloring, chromatic polynomials, edge coloring, planar graph coloring; Matching: maximum matching in bipartite graphs, maximum matching in general graphs; Networks: The Max-flow min-cut theorem, max-flow algorithm; NP-Complete Graph problems; Approximation

algorithms for some NP-Hard graph problems; Algorithms for some NP-Hard graph problems on special graph classes

ReferenceBooks:

1. *Narsingh Deo, "Graph Theory: With Application to Engineering and Computer Science", PHI, 2003.*
2. *R.J. Wilson, "Introduction to Graph Theory", Fourth Edition, Pearson Education, 2003.*
3. *Clark J. and Holton D.A, "A First Look at Graph Theory", Allied Publishers, 1995.*
4. *Grimaldi R.P, "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley, 1994.*
5. *Edgar G. Goodaire; Discrete Mathematics with Graph Theory, 3/e; Pearson; 2019*
6. *Singh, G.S.; Graph Theory; PHI; 2020*
7. *S. Pirzada; An Introduction to Graph Theory; 2012; Universities Press*

COURSE OUTCOMES:

The students will be able to

CO1: To understand and apply the fundamental concepts in graph theory

CO2: The course aims at presenting a rigorous introduction to graph algorithms

CO3: To apply graph theory based tools in solving practical problems

CO4: To find the approximation algorithms for graph NP-complete problems.

CO5: To formally describe an algorithm and estimate its complexity

CO6: To apply principles and concepts of graph theory in practical situations

MS5148 ADVANCED ALGORITHM CREDITS-3

UNIT - I

Analysis Techniques: Growth functions, Recurrences and solution of recurrence equations;
String Matching: Naive String Matching, Rabin-Karp algorithm, matching with finite Automata, Knuth-Morris – Pratt algorithm.

UNIT - II

Number Theoretic Algorithms: Elementary notions, GCD, Modular arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element RSA Cryptosystem, Primality testing, Integer factorization

UNIT -III

DFT and FFT efficient implementation of FFT, Graph Algorithms, Bellman-Ford Algorithm Shortest paths in a DAG, Johnson's Algorithm for sparse graphs, Flow networks and the Ford-Fulkerson Algorithm, Maximum bipartite matching.

Linear Programming: Formulating problems as linear programming, simplex algorithm, duality, Solving system of linear Equations.

UNIT-IV

Computational Geometry: Line segment properties, Clipping: Cyrus-Beck and Sutherland-Hodman Algorithms; Determining any pair of segment intersects, Convex hulls, Gift wrapping and Graham Scan; Removing hidden surfaces

NP-completeness: Examples, proof of NP-hardness,and NP-completeness.

Reference Books:

1. *Kleinberg and Tardos, Algorithm Design,1st edition, Pearson Education, 2013.*
2. *Gilles Brassard and Paul Bratley, Fundamentals of Algorithms, 1st edition, Pearson Education, 1995.*
3. *Cormen, Leiserson, Rivest, and Stein, Introductions to Algorithms, PHI, 2nd edition, 2002.*
4. *Ellis Horowitz; Sartaj Sahni : Fundamentals of Computer Algorithms; Universities Press; 2008*
5. *Harsh Bhasin : Algorithms; 1st Edn.; Oxford; 2015*
6. *Michael T. Goodrich , Roberto Tamassia : Design and Analysis of Algorithms; Wiley*
7. *Subhash K Shinde: Analysis of Algorithms, 1/e: Pearson, 2021*
8. *Panneerselvam, R. : Design and Analysis of Algorithms, 2nd Edn.l : PHI : 2021*

COURSE OUTCOMES:

The students will be able to

CO1: to design and analyze programming problem statements.

CO2:to choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

CO3: to describe major algorithmic techniques (divide-and-conquer, greedy, dynamic programming, Brute Force, Transform and Conquer approaches) and mention problems for which each technique is appropriate.

CO4: to describes how to evaluate and compare different algorithms using worst-case, average-case and best-case analysis.

CO5: to come up with analysis of efficiency and proofs of correctness.

CO6: to comprehend and select algorithm design approaches in a problem specific manner.

MS5152 COMPUTER VISION CREDITS-3

UNIT-1

The image, its representations and properties: Image representations a few concepts, Image digitization, Digital image properties, Colour images, Cameras: an overview. Mathematical and physical background – Linear integral transforms, Images as stochastic processes, Image formation physics.

UNIT-2

Data structures for image analysis: levels of image data representation, traditional image data structures, and Hierarchical data structures. Image understanding-fitting via random sample consensus, point distribution model

UNIT-3

Segmentation II: Mean Shift Segmentation , Active contour models – snakes, Geometric deformable model – level sets and geodesic active contours, Fuzzy connectivity, Towards 3D graph – based image segmentation, Graph cut segmentation

UNIT-4

3 D Vision Geometry: 3 D Vision tasks, basics of projective geometry, A Single perspective camera, Scene reconstruction from multiple views, two camera stereopsis, Use of 3D vision Shape from X, Full 3D objects, 3D model-based vision, 2D view based representations of a 3D scene.

Reference Books:

1. *Milan Sonka, Vaclav Hlavac, Roger Boyle, "Digital Image Processing and Computer Vision" Cengage Learning, 1st Edition, 2008*
2. *Gonzales Woods, Digital image processing, 3rd Edition, Pearson Education, 2007.*
3. *Anil K. Jain, Fundamental of Digital Image Processing, 1st edition, PHI Pub. 1988.*
4. *S Jayaraman, S Esakkirajan, T Veerakumar : Digital Image Processing : 2nd Ed.; MGH; 2020*
5. *S. Sridhar; Digital Image Processing: 2/e: Oxford : 2016*
6. *Sudhir Shelke & Pramod B. Patil : Digital Image Processing: Vikas Pub. House; 2016*
7. *Milan Sonka; Vaclav Hlavac : Image Processing, Analysis, and Machine Vision; 4/e ; Cengage; 2015*

Course Outcomes

CO1: Describe different image representation, their mathematical representation and different their data structures used.

CO2: Classify different segmentation algorithm for given input

CO3: Create a 3D object from given set of images

CO4: Detect a moving object in video using the concept of motion analysis

CO5: Recognize the object using the concept of computer vision