MASTER OF SCIENCE IN COMPUTER SCIENCE

M.Sc. (CS)

Detailed syllabi for students admitted

*To*

KIIT Deemed to be University



ACADEMIC URRICULA

2021

2023

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SCHOOL OF COMPUTER APPLICATIONS

Kalinga Institute of Industrial Technology (KIIT)

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

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COURSE STRUCTURES

MASTER OF SCIENCE IN COMPUTER SCIENCE

(2021 – 2023)

Kalinga Institute of Industrial Technology

(Deemed to be University)

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### PROGRAM EDUCATIONAL OBJECTIVES

They are expected to accomplish the following objectives in a few years after M.Sc. (CS) graduation:

**PEO1:** Pursue a successful career in the field of computer applications, contribute significantly to their profession in industry, research and academia or undertake entrepreneurial endeavours.

**PEO2:** Continuously learn, engage and update themselves to carryout independent or collaborative research, and address constantly evolving technological and global challenges in their field of expertise.

**PEO3:** Develop leadership skills and demonstrate professional, social and ethical responsibilities as an individual.

### PROGRAMME OUTCOMES

Master of Science in Computer Science 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.

### PROGRAM 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.

**FIRST SEMESTER (AUTUMN) (M.Sc.)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **THEORY** | | | | | | |
| **SL.NO.** | **COURSE CODE** | **COURSE** | **L** | **T** | **P** | **CREDITS** |
| 01 | MC4101 | Programming and Data Structures | 3 | - | - | 3 |
| 02 | MS4001 | Computer Architecture | 3 | - | - | 3 |
| 03 | MC4105 | Discrete Mathematics | 3 | - | - | 3 |
| 04 | MC4107 | Database Management System | 3 | - | - | 3 |
| 05 | MC4109 | Operating Systems | 3 | - | - | 3 |
| **PRACTICAL** | | | | | | |
| 06 | MC4191 | Programming and Data Structures Lab | - | - | 4 | 2 |
| 07 | MC4193 | Database Management System Lab | - | - | 4 | 2 |
| 08 | MC4195 | Soft Skill Lab | - | - | 2 | 1 |
| **TOTAL** | | | - | - | - | **20** |

**SECOND SEMESTER (SPRING)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **SL. NO.** | **COURSE CODE** | **COURSE** | **L** | **T** | **P** | **CREDITS** |
| 01 | MS4002 | Computer Communication Networks | 3 | - | - | 3 |
| 02 | MC4104 | Design and Analysis of Algorithms | 3 | 1 | - | 4 |
| 03 | MC4106 | Object Oriented Programming | 3 | - | - | 3 |
| 04 | MC4108 | Software Engineering | 3 | - | - | 3 |
| 05 | MS4004 | Machine Learning | 3 | - | - | 3 |
| **PRACTICAL** | | | | | | |
| 06 | MC4192 | Java Lab | - | - | 4 | 2 |
| 07 | MS4094 | Machine Learning Lab using Python | - | - | 4 | 2 |
| 08 | MC4196 | Professional Communication Lab | - | - | 2 | 1 |
| **TOTAL** | | | - | - | - | **21** |

**THIRD SEMESTER (AUTUMN)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **THEORY** | | | | | | |
| **SL. NO.** | **COURSE CODE** | **COURSE** | **L** | **T** | **P** | **CREDITS** |
| 01 | MS5001 | Data Analytics | 3 | - | - | 3 |
| 02 | MC5103 | Information and Cyber Security | 3 | 1 | - | 4 |
| 03 | MC5105 | Cloud Computing | 3 | - | - | 3 |
| 04 |  | Elective - I | 3 | - | - | 3 |
| 05 |  | Elective - II | 3 | - | - | 3 |
| **PRACTICAL** | | | | | | |
| 06 | MS5091 | Data Analytics Lab | - | - | 4 | 2 |
| **TOTAL** | | | - | - | - | **18** |

**FOURTH SEMESTER (SPRING)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **THEORY** | | | | | | |
| **SL. NO.** | **COURSE CODE** | **COURSE** | **L** | **T** | **P** | **CREDITS** |
| 01 | MS5002 | Theory of Computation | 3 | - | - | 3 |
| 02 | MS5004 | Image Processing | 3 | - | - | 3 |
| **SESSIONAL** | | | | | | |
| 04 | MS5082 | Project Work | - | - | - | 12 |
| **TOTAL** | | |  |  |  | **18** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CREDIT DISTRIBUTION** | | | | |
| Semester 1 | Semester 2 | Semester 3 | Semester 4 | Total |
| 20 | 21 | 18 | 18 | 77 |

**Elective-I**

MS 5021 – Internet of Things

MS 5023 – Geographic Information System

MS 5025 – Wireless Sensor Networks

MC 5121 – Object Oriented Analysis and Design

MC 5129 – Management Support System

MC 5131 – Mobile Applications Development

**Elective – II**

MS 5041 – Principles of Optimization Theory

MS 5043 – Natural Language Processing

MS 5045 – Information Storage Management

MC 5145 – Soft Computing

MC 5147 – Mobile Computing

MC5149 – Block Chain Architecture

**DETAILED SYLLABI**

**FIRST SEMESTER**

### MC4101 PROGRAMMING AND DATA STRUCTURES CREDITS-3

#### UNIT - I

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

#### UNIT - II

Arrays, functions, strings, recursion, Tower of Hanoi problem, storage classes, structures, Union, pointer and File Handling.

#### UNIT - III

**Development of Algorithm**s: 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 Publication, 2014.*
2. *Ellis Horowitz, Sartaj Sahani, Fundamentals of Data Structures in C, 2nd edition, University Press, 2008.*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MS 4101 COMPUTERARCHITECTURE CREDITS-3**

#### UNIT - I

**Fundamentals of Digital Electronics:** Number systems, Floating Point Arithmetic, Error Detection and Correction, Boolean algebra, Minimization techniques, Sum of min terms, Product of max terms, Simplification using Karnaugh’s Map (up to 4 variables), Combinational Circuits, Sequential Circuits, Shift Register, Counters, Design of Combinational and Sequential Circuits.

#### UNIT - II

**Basic Computer Organization and Design:** Von Neumann Architecture, Instruction codes, Computer registers, Computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-output and interrupt, Design of Basic computer, Design of Accumulator Unit.

#### UNIT - III

**Central Processing Unit:** Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, Data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC), Pipeline Processing, Parallel Processing.

**Input-Output organization:** Peripheral Devices, I/O output interface, Asynchronous data transfer, Modes of transfer, Priority Interrupt, DMA, Input output Processor, Serial Communication.

**Memory Organization:** Memory Hierarchy, Main Memory, Cache Memory.

#### UNIT - IV

**Programming the Basic Computer:** Introduction, Machine Language, Assembly Language, the

Assembler, Program loops, Programming Arithmetic and Logic Operations, Subroutines, I-O Programming, Ten Advanced Optimization of Cache Performance, Memory Technology and Optimization, Protection, Crosscutting Issues, Memory Hierarchies in the ARM Cortex-A8 and Intel Core i7.

***Reference Books:***

1. *Mano M Morris, Computer System Architecture, 3rd Edition (Updated), Pearson, 2016.*
2. *William Stallings, Computer Organization and Architecture: Designing for Performance, 9thEd., Pearson*
3. *Hamacher, Computer Organization, 5th Edition, Mc Graw Hill Education, 2011.*
4. *John P Hayes, Computer Architecture and Organization, 3rd Edition, Mc Graw Hill Education, 2017.*
5. *Clements, Alan: Computer Organizations & Architecture: 1st Edition, Cengage: 2014*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Illustrate the working of Computer Systems.

**CO2:** Classify and interpret the Instruction Set Architecture.

**CO3:** Solve problems related to the advanced pipelining techniques.

**CO4:**Analyze the system performance.

**CO5:** Prioritize the current state in memory system design.

**CO6:** Design alternate/ advanced architecture using data flow computing.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC4105 DISCRETE MATHEMATICS CREDITS-3**

#### UNIT I

#### Sets and Proposition: Finite and Infinite Sets, Combinations of Sets, Multisets, Venn Diagrams. Propositional Logicand 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: 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. Introduction to functions and its types, 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**: 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, Monoid, Abelian, Cyclic, Factor, 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, K-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”, McGraw Hill International, 7th Edition, 2011.*
2. *T.Veerarajan," Discrete Mathematics “. Tata McGraw Hill,2012.*
3. *B. Kolman, R. C. Busby, S. Ross, “Discrete Mathematical Structures”, PHI, 6th. Edition, 2010.*
4. *S. Lipschutz, Discrete Mathematics, Tata McGraw Hill, 2nd. Edition, 2005*
5. *Richard Johnsonbough, “Discrete Mathematics”, Pearson Education, 8th. Edition, 2018.*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  | **3** |  |  |  |  |  |  | **3** |  |
| **CO2** |  | **3** |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **3** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  | **3** |  |  |  |  | **2** |  |  |  | **3** |  | **2** |
| **CO6** |  |  |  |  |  |  | **3** |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

#### MC 4107 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, 7th Edition, 2015.*
2. *Silberschatz, H. F. Korth and S. Sudarshan, Database System Concepts, MGH, 6th Edition, 2011.*
3. *Rini Chakrabarti and S. Dasgupta, Advanced Database Management System, Wiley-2019*
4. *J.J. Adamski and P.J. Pratt, Database Management Concepts, 7th Edition, Cengage-2012*
5. *P.S. Gill, Database Management Systems, 1st. Edition, Wiley-2017*
6. *C. Corone,, S. Morris & P. Rob, Database Principles Fundamentals of Design Implementation*

*and Management, 10th Edition, Cengage, 2013*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

##### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** | **3** |  |  |  | **2** |  |  |  |  |  |  |  |  | **3** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  | **3** |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC 4109 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, 2018.*
2. *D. M. Dhamdhere , Operating Systems a Concept Based Approach, 3rd Edition, McGraw Hill Education, 2017.*
3. *P. C. Bhatt, An Introduction to Operating Systems: Concepts & Practice, 4th Edition, Prentice Hall of India, 2013.*
4. *Andrew S Tanenbaum and Albert S Woodhull, Operating System Design & Implementation, 3rd Edition, Pearson Education, 2015.*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

##### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

## PRACTICALS

### MC 4191 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.

### MC 4193 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.

### MC 4195 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*

## SECOND SEMESTER

### MS 4002 COMPUTER COMMUNICATION 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", 5th Edition, TMH, 2017*
2. *A.S. Tanenbaum, Computer Networks, 5th Edition, Pearson Education. 2013*
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*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** | **1** |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  | **3** |  |  |  |  |  |  |  |  |  | **2** | **3** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **3** |
| **CO6** | **3** |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC 4104 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, 2009.*
3. *E.HorwitzS.Sahani, S.Rajasekharn, Fundamentals of Computer Algorithms, 2nd Edition, University Press, 2008.*
4. *Michael T. Goodrich, Algorithm Design: Foundations, Analysis & Internet examples, 1st Edition, Wiley, 2001.*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  | **1** |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  | **3** |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  | **3** |  | **2** |
| **CO6** |  |  |  |  | **3** |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

### MC 4106 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, Datagram’s – 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 Result set, Result Set metadata, Inserting and updating records, JDBC and AWT, Connection pooling.

***Reference Books:***

1. *PatricNaughton, Herbert Schildt, Java 2 Complete Reference, 9th Edition, McGraw Hill Education, 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, McGraw Hill Education, 2017*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC 4108 SOFTWARE ENGINEERING CREDITS-3**

#### UNIT - I

**Introduction:** Emergence of software engineering, changes in software development practices, system engineering and role of system analyst. **Software Life Cycle Models:** Need for a life cycle model, phase entry and exit criteria, classical waterfall model, iterative waterfall model, iterative waterfall model, prototype model, evolutionary model, V model, Spiral model, selection criteria for the various models and Agile model development.**Requirement Analysis and Specification:** Requirement gathering and analysis, functional requirements, organization of the SRS document, decision trees and decision tables, formal system specification, axiomatic specification, algebraic specification and 4GL.

#### UNIT – II

**Introduction to Design:** Importance of design, design activities and methodologies, good design characteristics, cohesion, coupling, layered modular design, fan–in and fan–out, approaches to design.

**Function Oriented Design Approach:** Structured analysis, data flow diagrams, structured design, transform analysis and transaction analysis, structure chart. **Object Oriented Design with UML:** Overview of Object-Oriented Concepts, UML (Unified Modeling Language), UML Diagrams for Users View, Structural View, Behavioral View, Implementation View and Environmental View, Designing Use Case Diagram, Class Diagram, Sequence Diagram and State Charts.

#### UNIT - III

**Coding:** Coding standards, code walkthrough, code inspection, documentation – internal and external documentation and Gunning’s Fog index. **Testing:** Validation and verification, fault and failure, debugging, debugging approaches, unit testing, black box testing, equivalence class partitioning, boundary value analysis, white box testing, integration testing, system tests – alpha, beta and acceptance are testing, stress testing and regression testing. **Maintenance:** Characteristics of maintenance, types of maintenance, software reverse engineering, maintenance process model and maintenance cost estimation.

#### UNIT – IV

**Software Project Management:** Roles of a project manager, project planning, project size estimation, project estimation techniques - empirical, heuristic (COCOMO) and analytical, staffing estimation, scheduling, organization and team structure, risk management and SCM. **Reliability and Quality Management:** Introduction to reliability, reliability metrics, reliability growth modelling, software quality, ISO 9001, SEI CMM and Six Sigma. **Computer Aided Software Engineering:** Scope of CASE, benefit of CASE, CASE in software life cycle, second generation CASE tool and CASE environment architecture.

***Reference Books:***

1. *Rajib Mall: Fundamentals of Software Engineering, 4th Edition, Prentice Hall of India, 2014*
2. *I. Summerville: Software Engineering 10th Edition, Pearson Education, 2017*
3. *Roger S. Pressman: Software Engineering: A Practitioner’s Approach, 7th Edition, MGH,2009*
4. *Craig Larman: Applying UMI and Patterns An introduction OOAD and the Unified Process, Pearson*
5. *Pankaj Jalote, Software Engineering: A Precise Approach, 1st edition, Wiley, 2015*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to **CO1:** Identify requirements of the software projects.

**CO2:** Understand the software requirements and translate them to Design and development process.

**CO3:** Apply and map various testing methods to the phases of SDLC.

**CO4:** Analyze the basic project management practices and tools in real life projects.

**CO5:** Evaluate various quality factors for software.

**CO6:** Develop small real-world project with the help of software engineering concepts.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
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\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC 4004 MACHINE LEARNING 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. *S.J. Russell & P. Norvig, Artificial Intelligence: A modern Approach, Pearson, 2009.*
2. *P.H Winston, Artificial Intelligence, Addison Wesley, 2011.*
3. *Khemani, D., A first Course in Artificial Intelligence, McGraw Hill Education, 2020*
4. *E Rich &K Knight, Artificial Intelligence, McGraw Hill Education; 3rd Edition, 2017.*

**COURSE OUTCOMES:**

After Completion of the course the student 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

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
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\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

## PRACTICALS

**MC 4192 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.

### MC 4194 MACHINE LEARNING LAB USING PYTHON CREDITS-2

Write program in Java, Python or R to implement the assignments

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.

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### MC 4196 PROFESSIONAL COMMUNICATION LAB CREDIT-1

#### UNIT-I

**Resume Writing:** Resume Basics – Structure, Sections, Formatting, Drafting and Exclusions. Types of resumes – Chronological, Functional and Hybrid. Cover Letters

#### UNIT-II

**Group Discussion:** GD basics – Structure, Motive, Seating, Format.GD Role-plays – Positive and Negative roles. Types – Topic based and Case study-based GD Strategies – Introduction, Discussion and Summarization.

#### UNIT-III

**Interview skills:**Types of Interviews- Structured, Unstructured and Semi-structured Interview Strategies – Stress handling, Behavioral interview questions, Convincing skills. Interview preparation – Effective communication skills, Dress – code, Research about the company, Subject knowledge, Cognitive flexibility and adaptability.

***Reference Books:***

1. *Lehman, Dufrene, Sinha , BCOM, Cengage Learning,2009*
2. *Bovee et al, Business Communication Today, 14th Edition Pearson,2018.*

## THIRD SEMESTER

### MS 5001 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, 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. *Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: EmergingBusiness Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.*
      2. *P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of*

*Polyglot Persistence", Addison-Wesley Professional, 2012.*

* + - 1. *Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.*
      2. *Rajkamal and Preeti Saxena, “Big Data Analytics”, 1st Edition, MGH, 2019*
      3. *G. Sudha Sadasivam and R. Thirumahal, “Big Data Analytics”, 1st Edition, Oxford, 2020*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC 5103 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, D.N.Shah, 2nd Edition, Wiley*
2. *V. K. Pachghare: Cryptography and Information Security, 2ndEdition, PHI, 2015*
3. *Michael E. Whitman: Principles of Information Security, 5thEdition, Cengage, 2015*
4. *Forouzan: Cryptography & Network Security,3rdEdition, McGraw-Hill Education*
5. *William Stallings: Cryptography and Network Security Principles and Practices, 7thEdition, Pearson Education, 2017*
6. *B.L. Menezes & Ravinder Kumar: Cryptography, Network Security & Cyber Laws, 1st Edition, Cengage, 2018.*
7. *Atul Kahate: Cryptography and Network Security: 4th Edition, MGH, 2019.*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC 5105 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. *RajkumarBuyya, 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. *Arshdeep Bahga & Vijay Madisetti, “Cloud Computing : A Hands-on Approach”, Orient BlackSwan, 2014*
5. *Shailendra Singh, “Cloud Computing”, Oxford, 2018*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**ELECTIVE-I**

### MS 5021 INTERNET OF THINGS CREDITS-3

#### UNIT-I

**M2M to IoT:** Introduction: The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.

#### UNIT-II

**M2M to IoT**: A Market Perspective: Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.**M2M to IoT:**An Architectural Overview: Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

**UNIT-III:**

**M2M and IoT Technology Fundamentals:** Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.

**UNIT-IV:**

**IoT Architecture & Reference Model:** Introduction, State of the art, Reference Model and architecture, IoT reference Model, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

**UNIT-V:**

**Real-World Design Constraints:** Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.**Industrial Automation:** Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC AESOP: from the Web of Things to the Cloud of Things,Commercial Building Automation: Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

***Reference Books:***

1. *Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, Academic Press,*
2. *Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT,*
3. *Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Understand constraints and opportunities of wireless and mobile networks for Internet of Things.

**CO2:**Analyze the societal impact of IoT security events.

**CO3:** Develop critical thinking skills.

**CO4:**Analyze, design or develop parts of an Internet of Things solution and map it toward selected business model(s)

**CO5:** Evaluate ethical and potential security issues related to the Internet of Things.

**CO6:** Design and implement real-life case studies.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MS 5023 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

#### UNIT V

#### 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. Pearson Education India, 2010.*
3. *Yang, Chaowei, and Qunying Huang.” Spatial cloud computing: a practical approach”. CRC Press, 2013.*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

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

**CO2:** Understanding the types of data models

**CO3:** Acquire knowledge of data intake and topology.

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

**CO5:** Evaluate data management functions and data outputs.

**CO6:** Design and implement real-life case studies.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

### MS 5025 WIRELESS SENSOR NETWORKS 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.

#### UNIT V

#### 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.

***Reference Books:***

1. *C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.*
2. *Wireless Sensor Networks – Ian F. Akyildiz and Mehmet Can Vuran -John Wiley and Sons Ltd, Publication,2010.*
3. *Wireless Sensor Network - a networking perspective, Jun Zhny and Abbos Jama Lipcar,Wiley 2009.*
4. *Wireless Sensor Network, Springer, C. Raghavendram, K Sivalingam and T. Znati, August 2005.*

**COURSE OUTCOMES:**

After Completion of the course the student will be able 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 latencyparameters.

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

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

### MC 5121 OBJECT ORIENTED ANALYSIS AND DESIGN CREDITS-3

#### UNIT-I

**Introduction:** Importance of modeling, process model, analysis and design, methodology, UML, views, design models and code. **Object Model:** UML and code, classes and objects, data redundancy, links and associations, assemblies and components.

#### UNIT-II

**Business Modeling:** Terms, concepts, use-cases, actors, generalization of use-case, extend and include stereotypes, use-case packaging. **Class and Object Diagrams:** Static and dynamic models, advanced classes, advanced relationships, generalization, aggregation, composition, reification, link classes, interfaces and packages.

#### UNIT-III

**Interaction Diagrams:**Classifier roles, association roles, Sequence diagram, Communication diagram, Interaction Overview diagram, and Timing diagram. **Advanced Behavioural Modeling:** States, events and transitions, semantics, non-determinism in a state chart diagram, actions and activities, composite states and timed event.

#### UNIT-IV

**Component Diagram:** Components, artifacts, compilation dependency, generalization dependency and dependency graphs. **Constraints:** UML constraints, 'xor' constraint, 'subset' constraints and introduction to OCL.

***Reference Books:***

1. *Mark Priestley, Practical Object-Oriented Design with UML, 2nd Edition, McGraw-Hill Education, 2003*
2. *Larman Craig, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3rdEdition, Pearson, 2015*
3. *Simon Bennett ,* [*Ray Farmer*](http://www.flipkart.com/author/ray-farmer)*,* [*Steve McRobb,*](http://www.flipkart.com/author/steve-mcrobb) *Object-Oriented Systems Analysis and Design Using UML,2nd Edition, McGraw Hill Education, 2010*
4. *AtulKahate, Object Oriented Analysis & Design, McGraw-Hill Education, 2007*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Define and differentiate the object-oriented design from procedure-oriented design.

**CO2:** Understand system requirements to determine the use cases and domain model of the problem domain.

**CO3:** Apply fundamentals of Class and Object modelling.

**CO4:**Analyze UML models to show the interaction between various objects and understand the limitations of the interaction diagram.

**CO5:** Evaluate the states of an objects and the importance of the object life cycle.

**CO6:** Design and implement real-life case studies.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

#### MC 5129 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.

##### UNIT-V

**Big Data and Future Direction of Business Analytics:** Big Data and Analytics, Business Analytics, Impact of Management Support 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,*](https://www.google.com/search?client=firefox-b-d&sa=X&biw=1536&bih=750&q=Ciara+Heavin&stick=H4sIAAAAAAAAAOPgE-LVT9c3NEyJt0gqM8uwVIJwk02TiiwtDSu0ZLKTrfST8vOz9cuLMktKUvPiy_OLsq0SS0sy8osWsfI4ZyYWJSp4pCaWZebtYGUEADnryExQAAAA&ved=2ahUKEwjnhf3m8p3rAhXVZCsKHa-SB8MQmxMoATARegQIERAD)[*Daniel J. Powe:*](https://www.google.com/search?client=firefox-b-d&sa=X&biw=1536&bih=750&q=Daniel+J.+Power&stick=H4sIAAAAAAAAAOPgE-LVT9c3NEyJt0gqM8uwVOIBcTOSC8qNswpKtGSyk630k_Lzs_XLizJLSlLz4svzi7KtEktLMvKLFrHyuyTmZabmKHjpKQTkl6cW7WBlBAB4fBRuUgAAAA&ved=2ahUKEwjnhf3m8p3rAhXVZCsKHa-SB8MQmxMoAjARegQIERAE) *Decision Support, Analytics, and Business Intelligence, Business Expert, Third Edition,2017*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Identify the guidelines for designing a management support system and phases of the decisionmaking 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.

##### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC 5131 MOBILE APPLICATIONS DEVELOPMENT CREDITS-3**

##### UNIT-I

**Introduction to Mobile Computing:** Introduction to Android Development Environment, Factors in Developing Mobile Applications: Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User.

##### UNIT-II

**UIs, VUIs and Mobile Apps:** Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal UIs and Services, Android Intents and Services, Characteristics of Mobile Applications, Successful Mobile Development, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider.

##### UNIT-III

**Communications Via Network and the Web:** State Machine, Correct Communications Model, Android Networking and Web, Telephony, Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony, Notifications and Alarms, Performance, Performance and Memory Management, Android Notifications and Alarms.

##### UNIT - IV

**Graphics, Performance and Multithreading**: Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia, Location, Mobility and Location Based Services, Android Putting It All Together (as time allows), Packaging and Deploying, Performance Best Practices, Android Field Service App, Security and Hacking (as time allows) , Active Transactions, More on Security, Hacking Android, Platforms and Additional Issues (as time allows), Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing.

***Reference Books:***

1. *John Horton, Android Programming for Beginners, 2nd Edition, Packt Publishing, 2018*
2. *Jeff Mcherter and Scott Gowell, Professional Mobile Application Development, Jeff Mcherter and Scott Gowell, Wrox (Wiley), 2012*
3. *Lorn Potter, Hands-On Mobile and Embedded Development with Qt 5 Build apps for Android, iOS, and Raspberry Pi with C++ and Qt., Packt Publishing, 2019*
4. *PrajyotMainkar, Salvatore Giordano, Google Flutter Mobile Development Quick Start, Packt Publishing,*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

##### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**ELECTIVE-II**

### MS5041 PRINCIPLES OF OPTIMIZATION THEORY CREDITS-3

#### UNIT - I

**Introduction:** Historical development, Applications of Optimization and Art of Modelling, introduction to

the fundamental theory of convex sets and functions, formulations of Objective Function andConstraints.

**UNIT - II**

**Static Optimization:** Non-Linear Optimization, Unconstrained Problems: First-Order Conditions; Second-Order Conditions. Constrained Problems: the Lagrange Multiplier Theory and the KKT Conditions. Applications: Least-Squares Problems.

UNIT - III

**Dynamic Optimization:** Optimization in Discrete Time, Dynamic Programming (DP), Principle of Optimality and Bellman Equation. Applications: the Shortest-Path Problemsand others. Introduction to Stochastic DP: Markovian Decision Processes and Stochastic Games.

**UNIT – IV**

**Optimization in Continuous Time:** Optimization in Infinite-Dimensional Space: Variational Idea and Basic Facts. Calculus of Variations: Euler-Lagrange Equation.Optimization Methods: The Gradient Method, Newton Method. Convergence Analysis of Algorithms.

UNIT – V

Network Flow Modeling : Formulating Flow, Network flow Algorithms and Integrality.Multiobjective Programming, Interior Point Methods, Karmarkar's algorithm.

***Reference Books:***

1. *Beck, Amir. Introduction to nonlinear optimization: Theory, algorithms, and applications with MATLAB. Society for Industrial and Applied Mathematics, 2014.*
2. *Dimitri Bertsekas. Nonlinear Programming. Athena scientific optimization and computation seriesof Optimization and computation series, 2016.*
3. *K. Deb. Optimization for Engineering DesignAlgorithms and Examples, Prentice-Hall ofIndia Pvt. Ltd., New Delhi, 1995.*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Develop a fundamental understanding of optimization models.

**CO2:** Apply appropriate theories, principles and concepts relevant to discrete optimization.

**CO3:** Plan and design applications using techniques and procedures appropriate to network flow problems.

**CO4:** Recognize the contribution and impacts of operations research in scientifically, economic, environmental and cultural terms.

**CO5:** Solve problems relevant to operations research using ideas and techniques some of which are at the forefront of the discipline.

**CO6:** Design optimized models and algorithms.

**Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes**

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MS 5043 NATURAL LANGUAGE PROCESSING CREDIT-3**

#### UNIT- I

**Introduction to NLP**, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

#### UNIT - II

**N-gram Language Models:** The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models, Lexical syntax. **Hidden Markov Models & Tagging**: Markov Models, Hidden Markov Models (HMMs), Trellis Algorithm, Viterbi Algorithm. Estimating the Parameters of HMMs, The Forward-Backward Algorithm, Implementation Issues, Task of Tagging, Tag sets, Morphology, Lemmatization, Tagging Methods, Manually Designed Rules and Grammars, Statistical Methods, HMM Tagging (Supervised, Unsupervised), Evaluation Methodology (examples from tagging), Precision, Recall, Accuracy, Statistical Transformation Rule-Based Tagging, Maximum Entropy, Maximum Entropy Tagging, Feature Based Tagging, Results on Tagging, Various Natural Languages.

#### UNIT - III

**Neural Networks in NLP:** Introduction to perceptron and backpropagation, Pattern Recognition and Machine Learning, LSTM Recurrent Neural Networks, Understanding LSTM Networks. **Syntactic parsing and Semantic Analysis:** Grammar formalisms and tree banks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing, Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing.

#### UNIT - IV

**Information Extraction (IE):** Named entity recognition and relation extraction. IE using sequence labelling, Machine Translation (MT): Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

***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*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
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| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
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\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

### MS 5045 INFORMATION STORAGE AND MANAGEMENT CREDITS-3

#### UNIT - I

**Storage Systems:** Introduction to Information Storage, Storage Systems Environment, Data Protection, Intelligent Storage Systems.

#### UNIT - II

**Storage Networking Technologies:**Introduction to Networked Storage,Storage Area Networks, Network-Attached Storage(NAS),IPSAN,Content Addressed Storage,Storage Virtualization,Object-Based and Unified Storage.

#### UNIT - III

**Business Continuity:**Introduction to Business Continuity,Information Availability & Monitoring & Managing Data center,Backup and Recovery

#### UNIT - IV

**Replication technologies:** Local Replication,Remote Replication,Concepts in Practice(EMC Time Finder,EMC Snap View and EMC Recover Point).

#### UNIT - V

**Storage Security and Management:**Security Framework, Storage security domains, List and analyzes the common threats in each domain, Security Implementations,Managing The Storage Infrastructure.

***Reference Books:***

1. *EMC Corporation, Information Storage and Management, Wiley, India.*
2. *Robert Spalding, ―Storage Networks: The Complete Reference ―, Tata McGraw Hill, Osborne.*
3. *Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill, Osborne*
4. *Meeta Gupta, Storage Area Networks Fundamentals, Pearson Education Limited*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Understand the logical and physical components of a Storage infrastructure.

**CO2:** Evaluate storage architectures, including storage subsystems.

**CO3:** Understand the various forms and types of Storage Virtualization.

**CO4:** Describe the different role in providing disaster recovery and business continuity capabilities.

**CO5:** Distinguish different remote replication technologies.

**CO6:** Understand the local and remote replication technologies.

**Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes**

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
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\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

### MC 5145 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 Logic and Genetic Algorithms: Synthesis and Applications, 2nd edition, 2018.*
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, , PHI/Pearson Education, 2015*
5. *Padhy, N.P. & Simon, S.P.: Soft Computing with MATLAB Programming: 1st Edn. : Oxford Universities Press. 2019.*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Ability to analyze the applications which can use fuzzy logic.

**CO2:**  Design Fuzzy Inference Systems and Fuzzy Controller.

**CO3:** Understand the difference between learning and programming and explore practical applications of Neural Networks.

**CO4:**  Appreciate the importance of optimizations and its use in computer engineering fields and other domains.

**CO5:**  Understand the efficiency of a hybrid system and how Neural Network and fuzzy logic can be hybridized to form a Neuro-fuzzy network and its various applications.

**CO6:**  Develop models by integrating various soft computing techniques.

**Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes**

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC5147 MOBILE COMPUTING CREDITS-3**

#### UNIT-I

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

**WirelessMedium 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. *GottapuSasibhushana 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:**

After Completion of the course the student 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.

#### Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MC5149 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- Permissions vs Permission-less Blockchain and Privacy, Cryptography and Crypto Primitives Hash-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 / supplychain: 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*

**COURSE OUTCOMES:**

After Completion of the course the student will be able to

**CO1:** Familiarized with Blockchain Terminology.

**CO2:**  Understand the concept of Blockchain, Bitcoin.

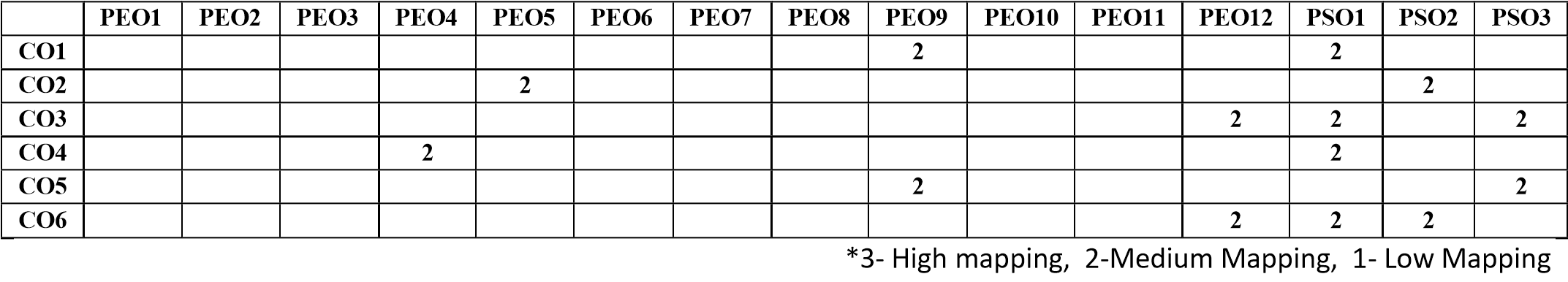
**CO3:**  Understand de-centralization.

**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.

**Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes**



**PRACTICALS**

### MS 5091 DATA ANALYTICS LAB CREDITS-2

Data Analysis and visualization using different tools, statistical analytics, Solving of use cases based on classification, clustering and regression analysis.

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## FOURTH SEMESTER

### MS 5004 IMAGE PROCESSING CREDIT-3

#### UNIT-I

REVIEW OF GRAPHICS FUNDAMENTALS

Basic raster graphical algorithm for 2D primitives, Line drawing algorithm, Circle drawing algorithm, Ellipse drawing algorithm, 2D and 3D transformations; Window, Viewport, Clipping algorithm, Bezier curve, b-spline curve, surfaces and Solid modeling.

**UNIT II**

Parallel projection-Perspective projection, Buffer algorithm, Scan line algorithm. Area subdivision and Ray tracing algorithms. Illumination mode, Specular reflection model, Shading models for curve surfaces, Recursive ray tracing, Texture mapping

**UNIT III**

ADVANCE MODELLING AND IMAGE PROCESSING

Procedural Models, Fractal Models, Grammar based models, particle systems. Image – Introduction, Elements of visual perception, Steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships

**UNIT IV**

COLOR MODELS AND SEGMENTATION

Color Model- RGB- CMYK -HSV- Watersheds and minimum spanning trees Deformable Methods –

Intelligent scissors/ livewires, active contours; DP snakes

**UNIT V**

IMAGE RECONSTRUCTION AND PATTERN ANALYSIS

Restoration, noise removal, clustering. K means, K-metoids, Mixture of gaussian, classification: discriminate function, supervised, un supervised, semi-supervised; classifiers: Bayes, KNN, ANN models.

***Reference Books:***

*1. Hearn & Baker, “Computer Graphics C version”, 2nd ed. Pearson Education, 2012.*

*2. Milan Sonka and Vaclav, “Analysis of Algorithm”, 3rd Ed (2007) Thomson Learning.*

*3. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson*

*4. Richard Szeliski, computer vision: algorithms and applications, springer-Verilog London limited*

*5. Computer vision: A modern approach, D.A.Forsyth, J.Ponce, Pearson education,2003.*

**COURSE OUTCOMES:**

After Completion of the course the student 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 image processing.

**CO5:**  Evaluate the various factors of color and shading.

**CO6:** Design image reconstruction and pattern analysis using related technologies.

**Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes**

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|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
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\*3- High mapping, 2-Medium Mapping, 1- Low Mapping

**MS5002 THEORY OF COMPUTATION CREDIT-3**

#### UNIT-I

#### Introduction, inductive Proofs Relations and Functions

#### UNIT-II

Regular Languages DFA, NFA Machines and their equivalence, Regular Expressions, Equivalence of Regular Expressions and Finite State Machines, Closure Properties of Regular Languages Proving Non-Regularity

#### UNIT-III

Context-free Languages Context-free Grammars, Derivations, Leftmost, Rightmost, Inherent Ambiguity, Parse Trees, Normal Forms, Proof of Containment of the Regular Languages Pushdown Automata,Equivalence of PDAs and Context-free Grammars Closure Properties of Context-free Languages

#### UNIT-IV

Pumping Lemma for both Regular & Context-free Languages, Proving Some Languages are not Context-free.

#### UNIT-V

Recursive and Recursively Enumerable Languages, Turing Machines Definition of Recursive and Recursively Enumerable, Church's Hypothesis, Computable Functions, Methods for Turing Machine Construction

***Reference Books:***

1. *Mishra & Chandrasekharan, Theory of computer science: Automata language and computation, Prentice Hall of India , 3rd Ed.*

*2. P. Linz, An Introduction to Formal Language and Computation, Narosa , 6th Ed.*

*3. Michael Sipser, Introduction to the Theory of Computation, Cengage Learning India, 3rd Ed.*

**COURSE OUTCOMES:**

After Completion of the course the student 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.

**Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PEO1** | **PEO2** | **PEO3** | **PEO4** | **PEO5** | **PEO6** | **PEO7** | **PEO8** | **PEO9** | **PEO10** | **PEO11** | **PEO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  |  |  |  |  |  |  |  | **2** |  |  |  | **2** |  |  |
| **CO2** |  |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** |  | **2** |
| **CO4** |  |  |  | **2** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO5** |  |  |  |  |  |  |  |  | **2** |  |  |  |  |  | **2** |
| **CO6** |  |  |  |  |  |  |  |  |  |  |  | **2** | **2** | **2** |  |

\*3- High mapping, 2-Medium Mapping, 1- Low Mapping