Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Board of Studies (Computer Science)
Syllabus
of
M. Sc. (Computer Science)
Choice Based Credit System (Semester Pattern)
wef. 2023-24 as per NEP 2020

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
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Pre-requisites to enrol for the M. Sc. Computer Science Programme:

The student who has completed the B. Sc. Coursewith Computer Science as one of the optional subject or Bachelor of Computer Application (BCA)or B. Sc. (IT) or B. Sc. (Data Science) with not less than 45% of aggregate marks (40% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enrol for M. Sc. (Computer Science)Part I (Semester I). However, the student who has completed four-year B. Sc. course [B. Sc. (Honours)/(Research) as per NEP- 2020] with Computer Science/Information Technology/Data Science as the major subject or Bachelor of Computer Application (BCA) with not less than 45% of aggregate marks (40% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enrol directly to M. Sc. (Computer Science) Part II (Semester III).

Credit distribution structure for two years Post Graduate Programme in Computer Science*

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT/FP	RP	Cum. Cr.	Degree
			Mandatory	Electives					
I	6.0	Sem. I	12 (3 theory + 2 Practical)	4	4			20	OneYear PG Diploma
		Sem. II	12 (3 theory + 2 Practical)	4		4		20	
Cum. Cr. For PG Diploma/ I year of PG			24	8	4	4	-	40	
Exit option: One Year PG Diploma 40 credits									
II	6.5	Sem. III	12 (3 theory +2 Practical)	4			4	20	PG Degree After 3 Yr UG or PG degree after 4-Ys UG
		Sem. IV	12 (3 theory +2 Practical)	4			6	22	
Cum. Cr. For II year of PG			24	8			10	42	
Cum. Cr. For 2 year of PG degree			48	16	4	4	10	82	

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Semester I

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
				(Th)	TU	P		Theory				Practical			
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Artificial Intelligence	MCS1T01	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Compiler Construction	MCS1T02	4	-	-	4	3	80	20	40	-	-	-	100
3	DSE	Elective 1	MCS1T03	4	-	-	4	3	80	20	40	-	-	-	100
4	RM	Research Methodology	MCS1T04	4	-	-	4	3	80	20	40	-	-	-	100
5	DSC	Practical Based on Paper MCS1T01 and MCS1T02	MCS1P01	-	-	6	3	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MCS1T03 and MCS1T04	MCS1P02	-	-	6	3	-	-	-	-	50	50	50	100
Total				16	-	12	**22**		**320**	**80**		**100**	**100**		**600**

CIE = Continuous Internal Evaluation and SEE = Semester End Examination

Semester II

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
				(Th)	TU	P		Theory				Practical			
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Cloud Computing	MCS2T05	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Machine Learning	MCS2T06	4	-	-	4	3	80	20	40	-	-	-	100
3	DSE	Elective 2	MCS2T07	4	-	-	4	3	80	20	40	-	-	-	100
4	OJT	Apprenticeship/Mini Project (Related to DSC)	MOJ2P01	-	-	8	4	3	-	-	-	50	50	50	100
5	DSC	Practical Based on Paper MCS2T05and MCS2T06	MCS1P03	-	-	6	3	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MCS2T07	MCS1P04	-	-	6	3	-	-	-	-	50	50	50	100
Total				12	-	20	**22**		**240**	**60**		**150**	**150**		**600**

Semester III

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
				(Th)	TU	P		Theory				Practical			
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Advanced Software Engineering	MCS3T08	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Network Security	MCS3T09	4	-	-	4	3	80	20	40	-	-	-	100
3	DSC	Digital Image Processing	MCS3T10	4	-	-	4	3	80	20	40	-	-	-	100
4	DSE	Elective 3	MCS3T11	4	-	-	4	3	80	20	40	-	-	-	100
5	RP	Research Project/ Dissertation (Core)	MRP3P01	-	-	8	4	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MCS3T08 ,MCS3T09,MCS3T10 and MCS3T11	MCS1P05	-	-	4	2	-	-	-	-	50	50	50	100
Total				16	-	12	**22**		**320**	**80**		**100**	**100**		**600**

Semester IV

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
				(Th)	TU	P		Theory				Practical			
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Big Data Analytics	MCS4T12	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Computer Vision	MCS4T13	4	-	-	4	3	80	20	40	-	-	-	100
3	DSC	Deep Learning	MCS4T14	4	-	-	4	3	80	20	40	-	-	-	100
4	DSE	Elective 4	MCS4T15	4	-	-	4	3	80	20	40	-	-	-	100
5	RP	Research Project/ Dissertation (Core)	MRP4P02	-	-	12	6	-	-	-	-	100	100	100	200
Total				16	-	12	22		**320**	**80**		**100**	**100**		**600**

Total Credits for Four Semesters (Two Year Course): = 88

Total Marks for Four Semesters (Two Year Course):= 2400

Abbreviations:

DSC: Discipline Specific Course, **DSE**: Discipline Specific Elective **SEE:** Semester End Examination, **CIE:** Continuous Internal Evaluation, **OJT:** On the Job Training (Internship/Apprenticeship), **FP:** Field Project, **RM:** Research Methodology, **RP**: Research Project

Elective papers:

In addition to the mandatory papers, the student has to opt for ONE elective paper in each semester from the basket of elective papers mentioned in the following table.

Basket for Elective Courses (4 Credits each)

Semester	Course Category	Name of the course	Course Code
I	Elective 1	a) Computer Architecture & Organization b) Discrete Mathematics c) Equivalent MOOC course	MCS1T03
II	Elective 2	a) R Programming b) Neural Network c) Equivalent MOOC course	MCS2T07
III	Elective 3	a) Computer Graphics b) Internet of Things (IOT) c) Equivalent MOOC course	MCS3T11
IV	Elective 4	a) Design and Analysis of Algorithm b) Cyber Forensics a) Equivalent MOOC course	MCS4T15

The students can opt either the elective paper taught in the department in offline mode or any other equivalent online course of at least 4 credits offered by MOOC or any other such platform. The student should submit the passing certificate to the College in order to include the marks in the marksheet. **The MOOCs which is identical to courses offered in this scheme of M.Sc. Computer Science (in terms of contents) and are accessible to the student shall not be allowed for credit transfer.**

The objectives of the Program

1. To produce outstanding Computer Scientists who can apply the theoretical knowledge into practice in the real world and develop standalone live projects themselves.
2. To provide opportunity for the study of modern methods of information processing and its applications.
3. To develop among students the programming techniques and the problem solving skills through programming

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. The ability to apply theoretical foundations of Computer Science and problem-solving skills through programming techniques for complex real time problems using appropriate data structures and algorithms.
2. The ability to design/develop hardware and software interfaces along with database management to meet the needs of industry.
3. The ability to demonstrate personal, organizational and entrepreneurship skills through critical thinking, engage themselves in life-long learning by following innovations in business, science & technology
4. Ethics on Profession, Environment and Society: Exhibiting professional ethics to maintain the integrality in a working environment and also have concern on societal impacts due to computer-based solutions for problems.

M. Sc. (Computer Science)
Semester I

MCS1T01
Paper I: ARTIFICIAL INTELLIGENCE

Hours/Week : 4
Credits : 4

Course Objectives:

1. To impart artificial intelligence principles, techniques and its history.
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
3. To develop intelligent systems by assembling solutions to concrete computational problems

Course Outcomes:

- Evaluate Artificial Intelligence (AI) methods and describe their foundations.
- Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
- Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.
- Analyze and illustrate how search algorithms and planning play vital role in problem solving.

UNIT I

AI problems, AI Techniques, Tic-tac-toe, Question Answering, Problem as a state space search, A water jug problem, production system, Control strategies, Heuristic Search, Problem Characteristics, Production system characteristics, Design of search programs AI Search techniques :- Depth-first, Breadth-first search, Generate-and-test, Hill climbing, Best-first search, Constraint satisfaction, Mean-ends-analysis, A* Algorithm, AO* algorithm.

UNIT II

Knowledge Representation:- Representations and mappings, Knowledge Representations, Issues in Knowledge Representation, Predicate Logic:- Representing Instance and Isa Relationships, Computable Functions and predicates, Resolution, Natural Deduction, Logic programming, Forward versus Backward Reasoning, Matching, Control knowledge, Expert System.

UNIT III

Games playing: Minimax search procedure , adding alpha-beta cutoffs, additional refinements, Planning :- Component of a planning system, Goal task planning, Nonlinear planning, Hierarchical Planning.

UNIT IV

Understanding, Understanding as Constraint satisfaction, Natural Language Processing, Syntactic Processing, Unification grammars, Semantic Analysis, Introduction to pattern recognition, Parallel and Distributed AI, Psychological Modeling, Distributed Reasoning Systems.

Books:

1. Artificial Intelligence by Elaine Rich, Mcgrawhill Inc.
2. Artificial Intelligence and Expert Systems – Jankiraman, Sarukes (M)
3. Lisp Programming – RajeoSangal – (TMH)
4. Artificial Intelligence – Russell-Pearson- Ist Text book.
5. Principles of AI- Nils Nilson
6. A.I. by R.J.Winston - Pearson

M. Sc. (Computer Science)
Semester I

MCS1T02
Paper II: COMPILER CONSTRUCTION

Hours/Week : 4
Credits : 4

Course Objectives:

1. To gain knowledge on Language Processor.
2. Distinguish different computing models and classify their respective types
3. Show a competent understanding of the basic concepts of Syntax Analysis.

Course Outcomes:

- Demonstrate the knowledge of Lexical Analysis
- Derive an appropriate model of code generation.

UNIT I

Introduction: Language Processors, the structure of a compiler, Lexical Analysis, Syntax Analysis, Semantic Analysis, Intermediate Code Generation, Code Optimization, Code Generation, Symbol Table Management, The Grouping of Phases into Passes, Compiler-Construction Tools.Evolution of Programming Languages: The Move to High-Level languages, Impact on Compilers. Applications of Compiler Technology, Programming Language Basics

UNIT II

A Simple Syntax-Directed Translator: Introduction, Syntax Definition, Syntax-Directed Translation, Parsing:Top-Down Parsing, Predictive Parsing.
Lexical Analysis: The role of the lexical analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens: Transition Diagrams, Recognition of Reserved Words and Identifiers. The Lexical-Analyzer Generator 'Lex'.

UNIT III

Syntax Analysis: Introduction, Context-free grammars: The Formal Definition, Notational Conventions, Derivations and parse trees, Ambiguity. Writing a Grammar, Top-Down Parsing: Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) Grammars, Nonrecursive Predictive Parsing. Bottom-Up Parsing: Reductions, Handle Pruning, Shift-Reduce Parsing.
Intermediate-Code Generation: Variants of Syntax Trees, Three-Address Code, Types and Declarations: Type Expressions, Type Equivalence, Declarations. Type Checking: Rules, Type Conversions. Control Flow: Boolean Expressions, Short-Circuit Code, Flow-of-Control Statements, Control-Flow Translation of Boolean Expressions. Backpatching.

UNIT IV

Run-Time Environments: Storage Organization, Stack Allocation of Space, Heap Management.
Code Generation: Issues in Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs: Basic Blocks, Flow Graphs, Representation of Flow Graphs. Optimization of Basic Blocks: The DAG Representation of Basic Blocks, Finding Local Common Subexpressions, Dade Code Elimination, The use of Algebraic Identities, Representation of Array References. Peephole Optimization: Eliminating Redundant Loads and Stores, Eliminating Unreachable Code, Flow-of-Control Optimization.

Books:

1. Principles of Compiler Design - A.V. Aho, M. S. Lam, Ravi Sethi, J. D. Ullman. Second Edition, Pearson Education Inc.
2. Principles of Compiler Design - A.V. Aho, J. D.Ullman : Pearson Education.
3. Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech.
4. Engineering a Compiler-Cooper & Linda, Elsevier.
5. Compiler Construction, Louden, Thomson.

M. Sc. (Computer Science)
Semester I

Elective 1: MCS1T03
Paper III: COMPUTER ARCHITECTURE AND ORGANIZATION

Hours/Week : 4
Credits : 4

Course Objectives:

1. To provide knowledge on overview of IAS computer function and addressing modes.
2. Hardware and software implementation of arithmetic unit to solve addition, subtraction, multiplication and division.
3. To provide knowledge of memory technologies, interfacing techniques and sub system devices.

Course Outcomes:

- Provide fundamentals on machine instructions and addressing modes.
- Comprehend the various algorithms for computer arithmetic.
- Analyse the performance of various memory modules in memory hierarchy.
- Compare and contrast the features of I/O devices and parallel processors.
- Outline the evaluation of memory organization.
- Analyse the performance of Arithmetic logic unit, memory and CPU.

UNIT I

Principle of computer design : Software, hardware interaction, layers in computer architecture, central processing and machine language instruction, addressing modes, instruction types, instruction set selection, instruction and execution cycle.

UNIT II

Control Unit: Data path and control path design, microprogramming v/s hardwired control, pipelining in CPU design, RISC v/s CISC, superscalar processors.

UNIT III

Memory subsystem: Storage technologies, memory array organization, memory hierarchy, interleaving, cache memory and virtual memory including architectural aids to implement these.

UNIT IV

Input/ Output Processing: Bus Interface, Data transfer techniques, I/O interrupts and channels, Performance evaluation: SPEC marks, Transaction Processing Benchmarks.

Books:

1. Computer Architecture and Organization by Tenenbaum
2. Computer Architecture and Organization by J. P. Hayes.
3. Parallel Processing by Hwang
4. Computer Organization by Hamacher, Vranesic, Zaky (TMH)

M. Sc. (Computer Science)
Semester I

Elective 1: MCS1T03
Paper III: DISCRETE MATHEMATICAL STRUCTURE

Hours/Week : 4
Credits : 4

Course Objectives:

1 To cover certain sets, functions, relations and groups concepts for analyzing problems that arise in engineering and physical sciences.
2 To imparting to analyze the problems connected with combinatorics and Boolean algebra.
3 To solve calculus and integral calculus problems.

Course Outcomes:

- Observe the various types of sets, functions and relations.
- Understand the concepts of group theory.
- Understand the concepts of combinatorics.
- Understand the concepts of graph theory and its applications.
- Learning logic and Boolean algebra. Using these concepts to solve the problems

UNIT I

Mathematical Logic: Propositional Calculus: Connectives, statement formulas and truth tables, well-formed formulas, Tautologies, Equivalence of formulas, duality law, Tautological Implications, functionally complete set of connectives, other connectives. **Normal Forms**: CNF, DNF, PCNF, PDNF.

UNIT II

Fundamentals: Sets and Subsets, operations on sets, sequences, Division of the integer, Matrices, Methods of Proof, Mathematical Induction.
Counting: Permutations, Combinations, The pigeonhole Principle, Recurrence Relations.

UNIT III

Relations and Digraphs: Product sets and Partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of Relations, Equivalence Relations, Operations of Relations, Transitive Closure and Warshall's Algorithms.
Functions: Definition and Introduction, Permutation Functions, Growth of Functions.

UNIT IV

Order Relations and Structures: Partially Ordered Sets, Lattices.
Graph Theory: Basic Concept of Graph Theory, Euler Paths and Circuits, Hamiltonian Paths and Circuits.
Tree: Introduction, Undirected Tree, Minimal Spanning Trees.
Semigroups and Groups: Binary Operations Revisited, Semigroups, Products and Quotients of Groups.

Books:

1. Discrete Mathematical Structures By Bernard Kolman, Busby & Sharon Ross [PHI].
2. Discrete Mathematical Structures with Application to computer science By J. P. Tremblay & R. Manohar [Tata McGraw –Hill]
3. Discrete Mathematics with Graph Theory by Goodaire[PHI]
4. Discrete Mathematics by J.K.Sharma(McMillan)
5. Discrete Mathematics and its Applications by Kenneth Rosen (TMH)

M. Sc. (Computer Science)
Semester I

MCS1T04

Paper IV: RESEARCH METHODOLOGY

Hours/Week : 4
Credits : 4

Course Objectives:

1. To study and understand the research issues & challenges, research goals, scientific methods
2. To study processing and analysis of data, Quantitative and Qualitative data analysis.
3. Reviewing Literature and research papers, writing research papers, Thesis reports.

Course Outcomes:

- The basic concept of research and its methodologies, Identify appropriate research topics, select and define appropriate research problem and parameters.
- Prepare a project (to undertake a project)
- Organize and conduct research in a more appropriate manner, writing research report and thesis.

UNIT I

Introduction: meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research processes, criteria of good research, **Defining Research Problem:** necessity of defining the problem, techniques involved in defining a problem, **Research Design**: meaning of research design, need for research design, features of good design, different research designs, basic principles of experimental design.

UNIT II

Methods of Data Collection: Collection of primary data, Observation method, Methods of Data collection, Interview Method, Collection of data through questionnaire, Collection of data through schedules, Difference between questionnaire and schedules, **Processing and Analysis of Data:** Processing operations, Problems in processing, Types of Analysis, Statistics in Research, Simple Regression analysis, multiple correlation and regressions, Partial correlation. **Quantitative Data analysis:** Types of quantitative data, data coding, visual aids for quantitative data analysis using statistics for quantitative data analysis, Interpretation data analysis result, evaluating quantitative data analysis, **Qualitative Data analysis:** Analyzing textual data, analyzing non-textual qualitative data, Grounded theory, computer aided qualitative analysis, evaluating qualitative data analysis.

UNIT III

Interpretation and Report Writing: Techniques of Interpretation, Significance of Report Writing, Different steps in Writing report, Layout of research report, type of report, oral presentation, mechanics of writing a research report **Python Tools:** File Handling, Introduction, Handling Binary data and CSV files, Zipping and Unzipping files, Directory **Regular Expression and Web scraping:** Introduction, Function of Re Module, web scraping.

UNIT IV

LaTeX: Writing scientific report, structure and components of research report, revision and Refining, writing project proposal, paper writing for international journals, submitting to editors conference presentation, preparation of effective slides, pictures, graphs and citation styles.

Books:

1. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
2. Briony J. Oastes, Researching Information Systems and Computing, SAG Publication India Pvt. Ltd., New Delhi.
3. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, Shashwat Pathak, Python Programming: A Practical Approach, First edition published 2022 by CRC Press.
4. F. Mittelbach and M. Goossens, The LATEX Companion, 2nd. ed. Addison Wesley, 2004.

M. Sc. (Computer Science)
Semester II

MCS2T05
Paper I: CLOUD COMPUTING

Hours/Week : 4
Credits : 4

Course Objectives:

1. To Understand fundamentals of cloud computing
2. To acquire good working knowledge of the essentials of Cloud Micro Services
3. To implement business specific cloud applications

Course Outcomes:

- Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
- Compare the advantages and disadvantages of various cloud computing platforms.
- Program data intensive parallel applications in the cloud.
- Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
- Identify security and privacy issues in cloud computing.

UNIT I

Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Federated Cloud/Intercloud, Types of Clouds. Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Service Technology. Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

UNIT II

Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP),Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security Features of Cloud and Grid Platforms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments, Understanding Core OpenStack Ecosystem. Applications: Moving application to cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud Services, Cloud Applications (Social Networking, E-mail, Office Services, Google Apps, Customer Relationship Management).

UNIT III

Basic Terms and Concepts, Threat Agents, Cloud Security Threats and Attacks, Additional Considerations. Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Hardened Virtual Server Images. Cloud Issues: Stability, Partner Quality, Longevity, Business Continuity, Service-Level Agreements, Agreeing on the Service of Clouds, Solving Problems, Quality of Service, Regulatory Issues and Accountability. Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud.

UNIT IV

Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking. How the Cloud Will Change Operating Systems,

Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing.Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.

Books:

1. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
2. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1st Edition.
3. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
4. Brian J.S. Chee and Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, CRC Press, ISBN :9781439806128.
5. Kris Jamsa, Cloud Computing: Saas, Paas, Iaas, Virtualization, Business Models, Mobile, Security, and More, Jones and Bartlett, ISBN :9789380853772.
6. John W. Ritting house, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press, ISBN : 978 1439806807, 1439806802.

M. Sc. (Computer Science)
Semester II

MCS2T06
Paper II: MACHINE LEARNING

Hours/Week : 4
Credits : 4

Course Objectives:

1. Ability to comprehend the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement their algorithms.
3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Course Outcomes:

- Understand the concepts of various machine learning strategies.
- Handle computational data and learn ANN learning models.
- Solve real world applications by selecting suitable learning model.
- Boost the performance of the model by combining results from different approaches.

UNIT I

Learning: Types of Machine Learning, Supervised Learning, The Brain and the Neuron, Design a Learning System, Perspectives and Issues in Machine Learning, Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination Algorithm, Linear Discriminants, Perceptron, Linear Separability, Linear Regression.

UNIT II

Multi-layer Perceptron: Going Forwards, Going Backwards: Back Propagation Error, Multilayer Perceptron in Practice, Examples of using the MLP, Overview, Deriving Back Propagation, Radial Basis Functions and Splines, Concepts, RBF Network, Curse of Dimensionality, Interpolations and Basis Functions, Support Vector Machines.

UNIT III

Learning with Trees: Decision Trees, Constructing Decision Trees, Classification and Regression Trees, Ensemble Learning, Boosting, Bagging, Different ways to Combine Classifiers, Probability and Learning, Data into Probabilities, Basic Statistics, Gaussian Mixture Models, Nearest Neighbor Methods, Unsupervised Learning, K means Algorithms, Vector Quantization, Self-Organizing, Feature Map

UNIT IV

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear Embedding, Isomap, Least Squares Optimization, Evolutionary Learning, Genetic algorithms, Genetic Offspring: Genetic Operators, Using Genetic Algorithms, Reinforcement Learning, Overview, Getting Lost Example, Markov Decision Process. Graphical Models: Markov Chain Monte Carlo Methods, Sampling, Proposal Distribution, Markov Chain Monte Carlo, Graphical Models, Bayesian Networks, Markov Random Fields, Hidden Markov Models, Tracking Method

Books:

1.Introduction to Machine Learning (Adaptive Computation and Machine Learning Series),EthemAlpaydin,Third Edition, MIT Press

2.Machine learning – Hands on for Developers and Technical Professionals, Jason Bell, Wiley

3.Machine Learning: The Art and Science of Algorithms that Make Sense of Datal, Peter Flach,Cambridge University Press.

4.Deep Learning , Rajiv Chopra, Khanna Publi.

5.Machine Learning, V. K. Jain, Khanna Publi

M. Sc. (Computer Science)
Semester II

Elective 2: MCS2T07
Paper III: R PROGRAMMING

Hours/Week : 4
Credits : 4

Course Objectives:

1. This course introduces R, which is a popular statistical programming language.
2. The course covers data reading and its manipulation using R, which is widely used for data analysis. It also covers different control structures and design of user-defined functions. Loading, installing and building packages .

Course Outcomes:

- Develop an R script and execute it
- Install, load and deploy the required packages, and build new packages for sharing and reusability 3. Extract data from different sources using API and use it for data analysis
- Visualize and summarize the data
- Design application with database connectivity for data analysis

UNIT I

Introduction, How to run R, R Sessions, Introduction to Functions, Important R Data - Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.

UNIT II

R Programming Structures, Control Statements, Loops, Looping Over Non, vector Sets, If Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return Returning Complex Objects, Functions are Objective, No Pointers in R Recursion, A Quicksort Implementation Extended, Example: A Binary Search Tree.

UNIT III

Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability Cumulative Sums and Products Minima and Maxima Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /Output, Accessing the Keyboard and Monitor, Reading and writer Files.

UNIT IV

Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot () Function – Customizing Graphs, Saving Graphs to Files. Probability Distributions, Normal Distribution Binomial Distribution Poisson Distributions other Distribution, Basic Statistics, Correlation and Covariance.

Books:

1. The Art of R Programming, Norman Matloff, Cengage Learning
2. Cotton, R., Learning R: a step by step function guide to data analysis. 1st edition.O'reilly Media Inc.
3. R for Everyone, Lander, Pearson Siegel, S. (1956), Nonparametric Statistics for the Behavioral Sciences, McGrawHill International, Auckland.

M. Sc. (Computer Science)
Semester II

Elective 2: MCS2T07
Paper III: NEURAL NETWORK

Hours/Week : 4
Credits : 4

Course Objectives:

1. To introduce the foundations of Artificial Neural Networks
2. To learn various types of Artificial Neural Networks

Course Outcomes:

- Ability to understand the concepts of Neural Networks.
- Ability to select the Learning Networks in modeling real world systems

UNIT I

Introduction: Feedforward Neural Networks: Artificial Neurons, Neural Networks and Architectures: Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Network Geometry of Binary Threshold Neurons and Their Network: Patterns Recognition and Data Classification, Convex Sets, Convex Hulls and Linear Separability, Space of Boolean Functions, Binary Neurons are pattern Dichotomizes, Non-linearly separable Problems, Capacity of a simple Threshold Logic Neuron, Revisiting the XOR Problem, Multilayer Networks.

UNIT II

Supervised Learning I: Perceptrons and LMS: Learning and Memory, From Synapses to Behaviour: The Case of Aplysia, Learning Algorithms, Error Correction and Gradient Descent Rules, The Learning Objective for TLNs, Pattern space and Weight Space, Perceptron Learning Algorithm, Perceptron Convergence Theorem, Perceptron learning and Non-separable Sets, Handling Linearly Non-Separable sets, α-Least Mean Square Learning, MSE Error Surface and its Geometry, Steepest Descent Search with Exact Gradient Information, μ-LMS: Approximate Gradient Descent, Application of LMS to Noise Cancellation

UNIT III

Supervised Learning II: Backpropagation and Beyond: Multilayered Network Architectures, Backpropagation Learning Algorithm, Structure Growing Algorithms, Fast Relatives of Backpropagation, Universal Function Approximation and Neural Networks, Applications of Feedforward Neural Networks, Reinforcement Learning

UNIT IV

Neural Networks: A Statistical Pattern Recognition Perspective: Introduction, Bayes Theorem, Classification Decisions With Bayes Theorem, Probabilistic Interpretation Of A Neuron Discriminant Function, Interpreting Neuron Signals As Probabilities, Multilayered Networks, Error Functions And Posterior Probabilities, Error Functions For Classification Problems

Generalization: Support Vector Machines and Radial Basis Function Networks: Learning from Examples and Generalization, Statistical Learning Theory Briefer, Support Vector Machines, Radial Basis Function Networks, Regularization Theory Route to RRBFNs, Generalized Radial Basis Function Network, Learning In RRBFNs, Image Classification Application, Other Models for Valid Generalization

Books:

1. Neural Network- A Classroom Approach, Satish Kumar, Tata McGraw Hill
2. Introduction to neural networks using MATLAB 6.0 by Sivanandam, S Sumathi, S N Deepa, Tata Mcgraw Hill
3. Neural networks A comprehensive foundations, Simon Hhaykin, Pearson Education 2nd edition 2004
4. Artificial neural networks - B.Yegnanarayana, Prentice Hall of India P Ltd 2005.
5. Neural networks in Computer intelligence, Li Min Fu, TMH 2003.
6. Neural networks James A Freeman David M S kapura, Pearson education 2004.

M. Sc. (Computer Science)
Semester III

MCS3T08
Paper I: ADVANCED SOFTWARE ENGINEERING

Hours/Week : 4
Credits : 4

Course Objective:
The course offers students to develop the ability to design software systems and analyse and test their performance.

Course Outcomes:
On successful completion of this subject students should be able to:

- To demonstrate an understanding of advanced knowledge of the practice of software engineering, design, validation, test and deployment.
- Use modern engineering principles, processes, and technologies to solve difficult engineering issues and tasks.
- Demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.
- Identify the proper ethical, financial, and environmental effects of their work.

Unit I
Introduction to Software Engineering, Software Engineering as a Layered Technology, Software Development Life Cycle, Generic View of process, A process framework, Process Model – Waterfall, Incremental, Evolutionary, Unified Process Model, Agile Process Model, Scrum, Dynamic System development model, CMMI.

Unit II
System Models: Context Model, Behavioural Model, Data Model, Object Model, Modelling with UML, Design Engineering: Design Process, Design Quality. Design Concepts: Abstraction, Architecture, Patterns, Information Hiding, Functional Independence, Modularity. Design Model: OO Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

Unit III
Testing Strategies, Strategic Approach to software testing: Verification, Validation, Error, Fault, Bug, Failure. Types of software testing: Unit Testing, White Box Testing, Black Box Testing, Software Quality Assurance: Software Reliability. Risk Management: Reactive, Proactive risk, Risk Identification, Risk Projection, Risk Refinement, RMMM plan.

Unit IV
Software Metrics: Software Sizing, LOC, FP Based estimations, estimation model, COCOMO Model, Project Scheduling, Time Line Chart, Software Configuration Management: Change Control and version control, software Reuse, Software Re-engineering, Reverse Engineering.

Books:
1. Software Engineering: A Practitioner's Approach, Roger Pressman, Macgraw Hill International Edition.
2. Fundamentals of Software Engineering, Carlo Gheezzi, Mehdi Jazayeri, Dino Mandrioli, PHI Publication.

M. Sc. (Computer Science)
Semester III

MCS3T09
Paper II: NETWOR SECURITY

Hours/Week : 4
Credits : 4

Course Objective: The course offers to impart knowledge on Network security, various encryption techniques, and intrusion detection and the solutions to overcome the attacks.

Course Outcomes:

On successful completion of this subject students should be able to:

- Classify the symmetric encryption techniques
- Illustrate various Public key cryptographic techniques
- Evaluate the authentication and hash algorithms.
- Basic concepts of system level security

Unit I

Introduction to Security Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Nonrepudiation, Cryptographic Techniques.

Unit II

Principles of Cryptography Symmetric Key Cryptography: DES, Block Cipher Modes of operation, Advanced Encryption Standard. Key distribution, Attacks. Public key Cryptography RSA, Cryptographic Hash functions, Authentication, Message Authentication Code (MAC), Digital Signatures, DSA Signatures.

Unit III

PKI and Security Practices Digital Certificates, MD5, SHA, Challenge Response protocols-Authentication applications, Kerberos, X.509, Securing Email, Web Security.

Unit IV

Software Vulnerabilities Buffer Overflow, Cross Site Scripting, SQL Injection, Case Studies on worms and viruses, Virtual Private Networks, Firewalls **Wireless Security** Security in Wireless Local Area Networks, Security in Wireless Ad Hoc and Sensor Networks, Security of the Internet of Things

Books:

1. W. Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education, 7th edition, 2016.
2. Behrouz A. Forouzan, Cryptography and networksecurityMCGrawHill3rdEdition
3. C. Kaufman, R. Perlman, M. Speciner, "Network Security: Private Communication in a Public World", Pearson Education, 2nd edition, 2002.

Reference Books:

1. Applied Cryptography - Schnier
2. J. Edney, W.A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i", Pearson Education, 2004.
3. E. Rescorla, "SSL and TLS: Designing and Building Secure Systems", Addison-Wesley, 2001.
4. B.L. Menezes, "Network Security and Cryptography", Wadsworth Publishing Company Incorporated, 2012.
5. Handbook of Applied Cryptography - Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone: Online Version

M. Sc. (Computer Science)
Semester III

MCS3T10
Paper III: DIGITAL IMAGE PROCESSING

Hours/Week : 4
Credits : 4

Course Objective: The course offers the students to develop the ability to understand image analysis algorithms and current applications in the field of digital image processing.

Course Outcomes:

On successful completion of this subject students should be able to:

• Know and understand the basics and fundamentals of digital image processing, digitization, sampling, quantization, and 2D-transforms.

• Operate on images using the techniques of smoothing, sharpening and enhancement. Understand the restoration concepts and filtering techniques.

Unit I

Fundamentals of Digital Image Processing:

Steps in Digital Image Processing, Components, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, Color image fundamentals, RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

Unit II

Image Enhancement: Spatial Domain: Gray level transformations, Histogram processing, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform, Smoothing and Sharpening frequency domain filters, Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Unit III

Image Restoration: Image Restoration, degradation model, Properties, Noise models, Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering

Unit IV

Image Segmentation: Edge detection, Edge linking via Hough transform, Thresholding, Region based segmentation, Region growing, Region splitting and merging, Morphological processing- erosion and dilation, Segmentation by morphological watersheds, basic concepts, Dam construction, Watershed segmentation algorithm.

Books:

1. Rafael C. Gonzalez, Richard E. Woods,‘ _Digital Image Processing‘, Pearson, Third Edition, 2010. Anil K. Jain, _Fundamentals of Digital Image Processing‘, Pearson, 2002.
2. Kenneth R. Castleman, _Digital Image Processing‘, Pearson, 2006.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, _Digital Image Processing using MATLAB‘, Pearson Education, Inc., 2011.
4. D,E. Dudgeon and RM. Mersereau, _Multidimensional Digital Signal Processing‘, Prentice Hall Professional Technical Reference, 1990.
5. William K. Pratt, _Digital Image Processing‘, John Wiley, New York, 2002.
6. Milan Sonka et al _Image processing, analysis and machine vision‘, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

M. Sc. (Computer Science)
Semester III

Elective 3: MCS3T11
Paper IV: COMPUTER GRAPHICS

Hours/Week : 4
Credits : 4

Course Objective:

1. To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
2. To make the student present the content graphically.

Course Outcomes:

On successful completion of this subject students should be able to:

- Students can animate scenes entertainment.
- Will be able to work in computer aided design for content presentation..
- Better analogy data with pictorial representation.

Unit I

Introduction of computer Graphics and its applications, Overview of Graphics systems, Video display devices, Raster scan display, Raster scan systems, video controller, Raster scan display processor, Random scan display, random scan systems, color CRT monitor, Flat panel display, Interactive input devices, Logical classification of input devices, Keyboard, mouse, Trackball and spaceball, Joysticks, Image scanner, Light pens, Graphics software, Coordinates representations, Graphics functions.

Unit II

Line drawing algorithms, DDA, Bresenham's, Circle generating, Mid-point circle algorithm, Ellipse generating, Polygon , Scan-line polygon fill, Boundary fill.

Unit-3 : Basic transformation's, Translation, Rotation, Scaling, Matrix representation's & homogeneous coordinates, Composite transformation's, Reflection, Two dimensional viewing, Two dimensional clipping, Line, Polygon, Curve, Text. 3D-transformation, Projection, Viewing, Clipping. Spline representation, Cubic spline, Bezier curve, Bezier surfaces, Beta spline, B-spline surfaces, Bspline curve, Hidden surfaces, Hidden lines, Z-buffer.

Unit IV

Fractal's geometry Fractal generation procedure, Classification of Fractal, Fractal dimension, Fractal construction methods. Color models, XYZ, RGB, YIQ, CMY & HSV, Shading algorithms, Shading model, Illumination model, Gouraud shading, Phong shading.

Books:

1. Computer Graphics by M. Pauline Baker, Donald Hearn, 2 Edition PHI.
2. Mathematical Element for Computer Graphics By. David F. Roger., J. Alan Adams, 2nd Edition, Tata McGHill.

Reference Books:

1. Principles of Interactive Computer Graphics By. William. M. Newmann. 2nd Edition Mc. Graw Hill.
2. Procedural Element for Computer Graphics By. David F. Roger. Mc. Graw Hill.
3. Computer Graphics By A.P. Godse, 2nd Editio TPPublication,
4. Computer Graphics By V.K. Pachghare, 2nd Edition, Laxmi Publication 5. Computer Graphics By Apurva Desai (PHI)

M. Sc. (Computer Science)
Semester III

Elective 3: MCS3T11
Paper IV: INTERNET OF THINGS (IOT)

Hours/Week : 4
Credits : 4

Course Objective: The course offers to impart knowledge on IoT and protocols, it expose the student to some of the electrical application areas where Internet of Things can be applied..

Course Outcomes:

On successful completion of this subject students should be able to:

- Able to understand the application areas of IoT
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Able to understand building blocks of Internet of Things and characteristics.

UNIT I

Introduction to IoT: Overview of IoT, Types of Iot frameworks, IoT Ecosystem, Design patterns for IoT, Iol architectures such as four-layer architecture, seven-layer architecture. IoT sensors and actuators: Understanding the types of sensors: Temperature, humidity, proximity, light and actuators used in IoT devices: pump, servo motor and LED and their applications.

UNIT II

IoT communication protocols: Learning about various communication protocols such as MQTT, CoAP, HTTP, and their usage in IoT devices.

IoT platforms and cloud computing: Understanding IoT platforms: Cloud based IoT platform, Edge Based IoT Platform, On-Premises Cloud Platform. Cloud computing. IoT devices communication with cloud using Messaging, PUB/SUB, API, and their role in the deployment of IoT applications.

UNIT III

Data Analytics and Machine Learning for IoT: Data collection and Storage in IoT. Techniques and tools used for analyzing and processing data generated by IoT devices, including machine learning algorithms.

Security and Privacy in IoT: Understanding the security and privacy challenges in IoT and techniques for securing IoT systems.

UNIT IV

Overview of Arduino, Introduction to programming languages and IDEs, Basic electronics concepts (resistors, capacitors, LEDs, etc.), Introduction to breadboards and circuit design, Variables, data types, and control structures, Functions and libraries, Sensors and Actuators, Introduction to sensors (e.g., temperature, humidity, light), Introduction to actuators (e.g., motors, LEDs, relays), Connecting and controlling sensors and actuators with Arduino

Case Studies on IoT Applications For Smart Homes, Cities, Environment-Monitoring And Agriculture

Books:

1. IoT Fundamentals; Networking Technologies, Protocols, and Use Cases for the Internet of Things David Hanes, Gonzalo Salgueiro, Patrick Grossetete Robert Barton, Jerome Henry
2. INTERNET OF THINGS Architecture and Design Principles, Raj Kamal, McGraw Hill Education (India) Private Limited
3. THE INTERNET OF THINGS KEY APPLICATIONS AND PROTOCOLS Olivier Hersent Actility, France David Boswarthick ETSI, France Omar Elloumi Alcatel-Lucent, France
4. Internet of Things -Architecture, Implementation and Security by Mayur Ramgir
5. Programming Arduino ™ Getting Started with Sketches Simon Monk

M. Sc. (Computer Science)
Semester IV

MCS4T12
Paper I: BIG DATA ANALYTICS

Hours/Week : 4
Credits : 4

Course Objective: The course offers students to develop understanding towards the basic concepts of Big Data, adaptation and planning of Big Data and Business Intelligence

Course Outcomes:

On successful completion of this subject students should be able to:

- Classify and categorize different types of Data Analytics
- frame Business Architecture
- Understand the use of Information and Communication Technology
- Differentiate Between Traditional data Analysis and Big Data Analytics
- Evaluate different Enterprise Technologies and Big Data Business Intelligence

Unit I

Concepts and terminology: Data Sets, Data Analysis, Data Analytics, Descriptive, Diagnostic, Predictive, Prescriptive Analytics, Business Intelligence, Big Data Characteristics, Volume, Velocity, Variety, Veracity and Value. Different types of Data, Structured, Unstructured, Semi-Structured, Meta Data Business Motivations and Drivers for Big Data Adoption.

Unit II

Big Data Analytics Life cycle - Business Case Evaluation, Data Identification, Data Acquisition and Filtering, Data Extraction, Data Validation and Cleansing, Data Aggregation and Representation, Data Analysis, Visualization, Utilization of Analysis Results.

Unit III

Enterprise Technologies - OLTP, OLAP, ETL Big Data BI, Clusters, Big Data Storage Concepts, Big Data Processing Concepts, Big Data Storage Technology - On Disk Storage Devices, NOSQL Databases, In-Memory Storage Devices.

Unit IV

Big Data Analysis Techniques - Quantitative, Qualitative, Statistical Analysis, Semantic Analysis, Visual Analysis, Introduction to Hadoop, Map Reduce, Hive, Pig, Spark and Big Data Analytics.

Books:

1. Big Data Fundamentals Concepts, Drivers & Techniques Thomas ErL, Wajid Khattak and Paul Buhler, Pearson Publication 2022.
2. Big Data Analytics Introduction to Hadoop, Spark and Machine- Learning, RajKamal, Preeti Saxena, McGraw Hill Publication, 2019.

M. Sc. (Computer Science)
Semester IV

MCS4T13
Paper II: COMPUTER VISION

Hours/Week : 4
Credits : 4

Course Objective: The course offers to introduce the student to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving.

Course Outcomes:

On successful completion of this subject students should be able to:

- Implement fundamental image processing techniques required for computer vision.
- Develop computer vision applications.

Unit I

Recognition Methodology: Conditioning, Labeling, Grouping, Extracting, Matching. Edge detection, Gradient based operators, Morphological operators, Spatial operators for edge detection. Thinning, Region growing, region shrinking, Labeling of connected components.

Unit II

Binary Machine Vision: Thresholding, Segmentation, Connected component labeling, Hierarchal segmentation, Spatial clustering, Split & merge, Rule-based Segmentation, Motion-based segmentation.

Unit III

Area Extraction: Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting). **Region Analysis**: Region properties, External points, Spatial moments, Mixed spatial gray-level moments, Boundary analysis: Signature properties, Shape numbers.

Unit IV

Facet Model Recognition: Labeling lines, Understanding line drawings, Classification of shapes by labeling of edges, Recognition of shapes, Consisting labeling problem, Back-tracking, Perspective Projective geometry, Inverse perspective Projection, Photogrammetry - from 2D to 3D, Image matching: Intensity matching of ID signals, Matching of 2D image, Hierarchical image matching.

Books:

1. David A. Forsyth, Jean Ponce,"Computer Vision: A Modern Approach"
2. R. Jain, R. Kasturi, and B. G. Schunk, "Machine Vision", McGraw-Hill.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, 'Image Processing, Analysis, and Machine Vision" Thomson Learning.
4. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison- Wesley, 1993.

M. Sc. (Computer Science)
Semester IV

MCS4T14
Paper III: DEEP LEARNING

Hours/Week : 4
Credits : 4

Course Objectives: The course offers to understand major deep learning algorithms and to identify deep learning techniques suitable for a given problem.

Course Outcomes:

On successful completion of the course students will be able to:

- Solve various deep learning problems
- Apply autoencoders for unsupervised learning problems
- Implement Convolutional Neural Networks to image classification problems
- Apply recurrent neural network to sequence Learning Problem.

Unit I

Introduction to Neural Networks: Feed Forward Neural Networks, Backpropagation , Gradient Descent (GD) Principal Component Analysis: Eigenvalues and eigenvectors, Eigenvalue Decomposition Basis, Principal Component Analysis and its interpretations, Singular Value Decomposition.

Unit II

Autoencoders: Undercomplete Autoencoders, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Noise Robustness

Unit III

Convolutional Neural Networks: The Convolution Operation, Motivation, Pooling, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation.

Unit IV

Recurrent Neural Networks: Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, LSTMs, GRUs, The Challenge of Long-Term Dependencies, Attention Mechanism.

Books:

1. Neural Networks and Deep Learning A Textbook, Charu C. Aggarwal, Springer
2. Deep Learning from Scratch, Building with Python from First Principles, Seth Weidman, O'Reilly

Reference Books:

1. Deep Learning by Ian Good fellow, Yoshua Bengio and Aaron Courville MIT press

M. Sc. (Computer Science)
Semester IV

Elective 4: MCS4T15
Paper IV: DESIGN AND ANALYSIS OF ALGORITHM

Hours/Week : 4
Credits : 4

Course Objective: The course offers students to develop the ability to design, analyse and synthesize the important algorithmic design paradigms.

Course Outcomes:

On successful completion of this subject students should be able to:

- Produce thorough proofs of an algorithm's soundness.
- Demonstrate about important algorithms and data structures.
- Use key analytical techniques and concepts for algorithmic design.
- Combine effective algorithms in typical engineering design scenarios.

Unit I

Definition of Algorithm & its characteristics, Recursive and Non-recursive Algorithms, Time & Space Complexity, Definitions of Asymptotic Notations, Insertion Sort (examples and time complexity), Heaps & Heap Sort (examples and time complexity). **Divide & Conquer**: Concept of divide and Conquer, Binary Search (recursive), Quick Sort, Merge sort.

Unit II

Greedy Algorithm: Fractional Knapsack problem, Optimal Storage on Tapes, Huffman codes, Concept of Minimum Cost Spanning Tree, Prim's and Kruskal's Algorithm.

Unit III

Dynamic Programming: The General Method, Principle of Optimality, Matrix Chain Multiplication, 0/1 Knapsack Problem, Concept of Shortest Path, Single Source shortest path, Dijkstra's Algorithm, Bellman Ford Algorithm, Floyd- Warshall Algorithm, Travelling Salesperson Problem.

Unit IV

Branch & Bound: Introduction, Definitions of LCBB Search, Bounding Function, Ranking Function, FIFO BB Search, Traveling Salesman problem Using Variable tuple. Decrease and Conquer: Definition of Graph Representation, BFS, DFS, Topological Sort/Order, Strongly Connected Components, Biconnected Component.

Books:

1. Fundamentals of Computer Algorithms, Authors - Ellis Horowitz, Sartaz Sahani, Sanguthevar Rajsekaran Publication: - Galgotia Publications
2. Introduction to Algorithms (second edition) Authors: - Thomas Cormen, Charles E Leiserson, Ronald L.Rivest , Clifford Stein ,Publication: - PHI Publication

M. Sc. (Computer Science)
Semester IV

Elective 4: MCS4T15
Paper IV: CYBER FORENSICS

Hours/Week : 4
Credits : 4

Course Objective: The course offers to Identify, gather, and preserve the proof of a law-breaking and to track and prosecute the perpetrators in an exceedingly court of law.

Course Outcomes:

On successful completion of this subject students should be able to:

- To learn investigation tools and techniques, analysis of data to identify evidence.
- To analyze the technical Aspects & Legal Aspects related to cyber crime.

Unit I

Recent amendments in IT Act, internet & web technologies, web hosting and development, attributes in cyberspace and legal framework of cyberspace, hacking, virus, obscenity, pornography, programme manipulation, Copyright, Patent, software piracy, intellectual property rights, trademark, domain disputes, and computer security, etc., Encryption and Decryption methods. Search and seizures of evidence. Investigation of cyber crimes and tools for analysis.

Unit II

Information security: Domains, Common Attacks, Impact of Security Breaches. Protecting Critical Systems (Information Risk Management, Risk Analysis etc) Information Security in Depth Physical security (Data security Systems and network security) Program Security: Secure programs, Non-malicious program errors, Viruses and other malicious code, Targeted malicious code, Controls against program threats File protection mechanism, Authentication: Authentication basics, Password, Challenge response, Biometrics. Network Security: Threats in networks, Network security control, Firewalls, Intrusion detection systems, Secure e-mail, Networks and cryptography, Example protocols: PEM, SSL, IPsec. Principles of network forensics, Attack Trace-back and attributes, Critical Needs Analysis. IDS: Network based Intrusion Detection and Prevention Systems, Host based Intrusion Prevention System. Cloud Computing-Its Forensic and Security Aspects.

Unit III

Cyber Crime Investigations: Where Evidence Resides on Windows systems, Conducting a Windows investigation, File Auditing and Theft of information, Handling the Departing Employee, Steps in a Unix Investigation, Reviewing Pertinent Logs, Performing Keywords Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships, Detecting Trojan Loadable Kernel Models. Finding Network based Evidence, Generating Session data with TCP Trace, Reassembling sessions using TCP flow and Ethereal.

Unit IV

Open source tools for digital forensics and Registry Forensic- Open source, Open source examination platform, preparing the examination system, using LINUX and Windows as host, Study of Sleuth Kit: Installing Sleuth Kit, Sleuth Kit tools (Volume layer tools, File system Layer tools, Data unit Layer tools, Metadata Layer Tools) Registry Analysis, Understanding Windows Registry and Registry Structure.

Books:

1. C. P. Pfleeger, and S. L. Pfleeger, "Security in Computing", Pearson Education.

2. Computer Forensic Investigating Data and Image Files, EC Council Press
3. Robert Jones, Internet Forensics Using Digital Evidence to Solve Computer Crimes, O'Reilly Media Publication
4. Forouzan Data Communication and Networking McGraw Hill
5. Stallings, "Cryptography And Network Security: Principles and practice"
6. Kevin Mandia, Chris Prosise and Matt Pepe, Incident response and computer forensics, McGraw Hill Publication
7. Cory Altheide, Harlan Carvey, Digital Forensics with Open source Tools, Syngress Publication
8. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003
9. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRC 28 Press LLC, 2004.