OP JINDAL UNIVERSITY

Raigarh-Chhattisgarh

Scheme and Syllabus

Of

M. Tech.(01PG021)

Department of

Computer Science and Engineering

School of Engineering

SESSION: 2023- 2025

Approved scheme of teaching and syllabus for M. Tech. (Department of Computer Science and Engineering) by the members of the Board of Studies

Computer Science and Engineering

M. Tech (CSE)

Program Outcomes for Engineering Post Graduate Program

1. **Disciplinary knowledge:** Accomplish vertical expertise in chosen discipline and enhance ability to function in multidisciplinary domains.
2. **Research aptitude:** Ability and aptitude to exercise research intelligence in investigations/ innovations and to communicate the findings in a clear, concise manner.
3. **Project management:** Develop and apply knowledge of engineering and management principles to manage a project in a multidisciplinary environment.
4. **Ethics:** Gain knowledge of ethical principles and commit to professional ethics.
5. **Self-directed lifelong learning:** Ability to identify appropriate resources and learn independently for projects, research etc. using online resources.

Program Specific Outcomes

PSO_01: Having an ability to apply advanced techniques and tools and computation to effectively solve multi-disciplinary challenges in industry and society.

PSO_02: Having an ability to design and conduct experiments, as well as to analyze and interpret data, and synthesis of information.

PSO_03: Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning.

Scheme & Syllabus of M. Tech (CSE) Programme

Semester I

S. No.	Subject Code	Subject	Periods Per Week			Scheme of Examination and Marks				Credit L+[T+P]/2
						PRE**		ESE*	Total Marks	
			L	T	P	Mid Sem	TA			
1.	SOE-M-CSE101	Advanced Mathematics	3	1	0	30	20	50	100	4
2.	SOE-M-CSE102	Advanced Data Structures and Algorithms	3	0	0	30	20	50	100	3
3.	SOE-M-CSE103	Fundamental of Data Analytics	3	0	0	30	20	50	100	3
4.	SOE-M-CSE104	Data Mining & Data Warehousing	3	0	0	30	20	50	100	3
5.	SOE-M-CSE105	Elective 1	3	0	0	30	20	50	100	3
6.	SOE-M-CSE106	Data Structures and Algorithms Lab	0	0	4	0	30	20	50	2
7.	SOE-M-CSE107	Data Mining & Data Ware Housing Lab	0	0	4	0	30	20	50	2
8.	SOE-M-CSE108	Fundamental of Data Analytics Lab	0	0	4	0	30	20	50	2
9.	SOE-M-CSE109	Elective Lab 1	0	0	4	0	30	20	50	2
Total			15	1	16	150	220	330	700	24

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Elective-I

S. No	Subject Code	Subject Name
2.	SOE-M-CSE105(1)	Software Engineering
3.	SOE-M-CSE105(2)	IoT Technology & Applications
4.	SOE-M-CSE105(3)	Big Data & Cloud Computing

Elective Lab-I

S. No	Subject Code	Subject Name
1.	SOE-M-CSE109(1)	Software Engineering Lab
2.	SOE-M-CSE109(2)	Internet of Things (IoT) Lab
3	SOE-M-CSE109(3)	Big Data & Cloud Computing Lab

Scheme & Syllabus of M. Tech (CSE) Programme

Semester II

S. No	Subject Code	Subject	Periods Per Week			Scheme of Examination and Marks				Credit L+[T+P]/2
						PRE**		ESE*	Total Marks	
			L	T	P	Mid Sem	TA			
1.	SOE-M-CSE201	Next Generation Databases	3	0	0	30	20	50	100	3
2.	SOE-M-CSE202	Business Intelligent & Machine learning	3	0	0	30	20	50	100	3
3.	SOE-M-CSE211(X)	Elective II	3	0	0	30	20	50	100	3
4.	SOE-M-CSE213(X)	Elective III	3	0	0	30	20	50	100	3
5.	SOE-M-CSE210	Research Methodology	3	0	0	30	20	50	100	3
6.	SOE-M-CSE212(X)	Elective Lab II	0	0	4	0	30	20	50	2
7.	SOE-M-CSE207	Next Generation Databases Lab	0	0	4	0	30	20	50	2
8.	SOE-M-CSE208	Business Intelligent & Machine learning Lab	0	0	4	0	30	20	50	2
9.	SOE-M-CSE214(X)	Elective Lab III	0	0	4	0	30	20	50	2
Total			15	0	16	150	220	330	700	23

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Elective-II

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE211(1)	Signal Processing and Data Analytics
2.	SOE-M-CSE211(2)	Digital Image Processing
3.	SOE-M-CSE211(3)	Blockchain Fundamentals and Applications

Elective-III

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE213(1)	Information Retrieval
2.	SOE-M-CSE213(2)	Soft Computing
3.	SOE-M-CSE213(3)	Wireless Sensor Network and IoT

Elective Lab - II

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE212(1)	Signal Processing and Data Analytics Lab
2.	SOE-M-CSE212(2)	Digital Image Processing Lab
3.	SOE-M-CSE212(3)	Blockchain Fundamentals and Applications Lab

Elective Lab - III

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE214(1)	Information Retrieval Lab
2.	SOE-M-CSE214(2)	Soft Computing Lab
3.	SOE-M-CSE214(3)	Wireless Sensor Network and IoT Lab

Scheme & Syllabus of M. Tech (CSE) Programme

Semester III

S. No	Subject Code	Subject	Periods Per Week			Scheme of Examination and Marks				Credit L+[T+P]/2
						PRE**		ESE *	Total Marks	
			L	T	P	Mid Sem	TA			
1.	SOE-M-CSE-21-301	Elective IV	3	1	0	30	20	50	100	4
2.	SOE-M-CSE-21-302	Internship/ Project/ Research	0	0	16	0	100	100	200	8
3.	SOE-M-CSE-21-303	Seminar	0	0	6	0	50	50	100	3
4.	SOE-M-CSE-21-304	Elective V	3	1	0	30	20	50	100	4
Total			6	2	22	60	190	250	500	19

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Elective-IV

S. No	Subject Code	Subject Name
1.	SOE-M-CSE-21-301(1)	Web Analytics in Digital Marketing
2.	SOE-M-CSE-21-301(2)	Data Analysis & Decision Making in Business Analytics
3.	SOE-M-CSE-21-301(3)	Healthcare Data Analytics
4	SOE-M-CSE-21-301(4)	Operations Research

Elective-V

S. No	Subject Code	Subject Name
1.	SOE-M-CSE-21-304(1)	Deep Learning and Applications
2.	SOE-M-CSE-21-304(2)	Natural Language Processing
3.	SOE-M-CSE-21-304(3)	Digital Forensics and Malware

Scheme & Syllabus of M. Tech (CSE) Programme

Semester IV

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P) /2 (L+T+P)
				L	T	P	PRE**		ESE*	Total Marks	
							Mid Sem	TA			
1	SOE-M-CSE-21-401	CSE	Dissertation	0	0	32	0	200	200	400	16
TOTAL				0	0	32	0	200	200	400	16

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Programme	:	**M. Tech**	**Semester** :	**I**
Name of the Course	:	**Advanced Mathematics**	**Course Code:**	**SOE-M-CSE101**
Credits	:	**4**	**No of Hours :**	**4 Hrs./week**
Max Marks	:	**100**		

Course Description:

The course has been designed to understand the basic concepts of algebra. This course includes the study of algebra, probability theory, optimization techniques, Fourier series and transform and their applications. The concepts introduced has application in machine learning, data science and image processing.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Apply the concept of vector space over real and complex fields
CO2	Apply probability theory in real life applications.
CO3	Apply optimization techniques in in real life applications.
CO4	Apply Fourier series and Transform in the area of signal processing.
CO5	Apply mathematical techniques in the research

Syllabus:

UNIT-I: Linear Algebra I

Vectors and geometry in two and three space dimensions. Algebraic properties. Dot products and the norm of a vector. Important inequalities. Vector spaces, subspaces and vector space axioms. Complex vector spaces, Eigenvalues and eigenvectors.

UNIT-II: Linear Algebra II

Examples of linear systems. Geometry of linear equations. Gaussian elimination. Row echelon form. Homogeneous and nonhomogeneous systems of linear equations. Application to the intersection of lines and planes, Properties and composition of linear transformations. Rotations, reflections and stretches. Translations using homogeneous coordinates. One-to-one and onto transformations

UNIT-III: Probability Theory

Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central limit theorem, Poisson, Gaussian and Erlang distributions-examples.

UNIT-IV: Optimization Technique

Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Constrained Optimization, Lagrange multipliers, Gradient method – steepest descent method.

UNIT-V: Fourier series and Transform

Fourier series and Transform: Fourier series, integrals and transforms and their properties. One dimensional Fourier transform, Convolution theorem, Parseval's formula, Introduction to 2-dimensional Fourier transform. (8L)

Text Book

1. J. Defranza and D. Gagliardi, Introduction to Linear Algebra with Applications, McGraw-Hill
2. Scott L. Miller, Donald G. Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press.
3. Kreyzig, 'Advanced Engineering Mathematics'

Reference Book

1. Schaum's outlines of Linear Algebra by Seymour Lipschutz, Marc Lipson, McGraw-Hill Education (India) Private Limited, New Delhi
2. T. Veerarajan "Probability, Statistics and Random Pr ocess", 3 rd Edition, Tata Mc-Graw Hill Co.
3. Elsgolts, L. "Differential Equations and Calculus of Variations", MIR Publications.

CO-PO&PSO Correlation

Course Name: Advanced Mathematics								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**	**1**					**2**	
CO2:	**1**	**1**					**1**	**1**
CO3:	**1**	**2**					**2**	
CO4:	**2**	**2**				**1**	**1**	**1**
CO5:	**1**	**2**		**1**	**1**	**1**	**2**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme	:	**M. Tech.**	**Semester**	:	**I**
Name of the Course:		**Advanced Data Structures and Algorithms**	**Course Code:**		**SOE-M-CSE102**
Credits	:	**3**	**No of Hours**	:	**3 Hrs./week**
Max Marks	:	**100**			

Course Description:

Engineering Algorithms & Data Structures deals with the fundamental means to approach the design and analysis of algorithms in an effective and methodologically correct manner. The student will acquire knowledge about general techniques for the design and analysis of algorithms as well as a collection of significant examples of solutions to representative problems. Furthermore, the student will have the opportunity to supplement the theory by writing actual programs in the C language during laboratory sessions.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Argue the correctness of algorithms using inductive proofs and invariants.
CO2	Analyse worst-case running times of algorithms using asymptotic analysis.
CO3	Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
CO4	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyse them.
CO5	Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm.

Syllabus:

UNIT–I: Introduction

Abstract Data Types - Time and Space Analysis of Algorithms - Big Oh and Theta Notations - Average, best and worst-case analysis - Simple recurrence relations, Array and Linked Structure Implementation of Lists, Stacks and Queues - Applications -Array of Nodes and Dynamic Pointer Implementation of Linked Structures.

UNIT–II: Linear and Non-linear Data Structure

Cursors –Sets, Priority Queues –Definition and applications, Max Priority Queue ADT-Implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap, Sorting techniques, Priority Queues, Trees - Binary trees - Search trees - Balanced trees - Advanced tree structures- B trees - AVL trees, 2-3 trees, Splay trees – applications of trees.

UNIT–III: Graph

Graphs - Directed -Shortest path - Undirected graph - Minimal spanning tree Hashing – Dictionary - Applications of Graphs, Graph based data structure: Network based

UNIT–IV: Analysis and Design Methodology of Algorithms

Algorithms Analysis - Sorting - Searching - Design Techniques - Greedy Methods- Dynamic Programming - Divide and Conquer - Back Tracking – Applications.

UNIT-V: Advance Algorithms

Parallel Algorithms: - Basic Techniques- Work & amp; Efficiency – Distributed Computation - Heuristic & Approximation Approaches.

Text Books:

1. Alfred. V. Aho, John. E. Hopcroft, Jeffrey. D. Ullman, & quot; Data Structures and Algorithms, Addison-Wesley Publications., 1985.

Reference Books:

1. Mark Allen Weiss, & quot; Data Structures and Algorithm Analysis in C & quot; Second Edition, Pearson Education, Asia
2. Jean-Paul Tremblay, Paul.G. Sorenson, & quot; An Introduction to Data Structures with Applications & quot;, Tata Mc Graw Hill second edition, 1991.
3. Thomas. H. Cormen, Charles.E. Leiserson, Ronald. L. Rivest, & quot; Introduction to Algorithms & quot;, PHI 1998.
4. Ellis Horowitz, Sartaj Sahni, Songuthevan Rajasekaran, Fundamentals of Computer Algorithms, Galgotial Publications Pvt. Ltd.

CO-PO & PSO Correlation

Course Name: Advanced Data Structures and Algorithms								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**2**	**1**					**2**	
CO2:	**1**	**1**					**1**	**1**
CO3:	**2**	**2**					**2**	
CO4:	**2**	**2**				**1**	**1**	**1**
CO5:	**2**	**2**				**1**	**2**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme	:	**M. Tech.**	**Semester**	:	**I**
Name of the Course	:	**Fundamental of Data Analytics**	**Course Code:**		**SOE-M-CSE103**
Credits	:	**3**	**No of Hours**	:	**3 Hrs./week**
Max Marks	:	**100**			

Course Descriptions:

This course will cover fundamental algorithms and techniques used in Data Analytics. The statistical foundations will be covered first, followed by various machine learning and data mining algorithms. Technological aspects and visualization will also be covered. This course will provide exposure to theory as well as practical systems and software used in data analytics.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Find a meaningful pattern in data
CO2	Graphically interpret data
CO3	Implement the analytic algorithms
CO4	Handle large scale analytics projects from various domains
CO5	Develop intelligent decision support systems

Syllabus:

UNIT-I: Introduction

Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning.

UNIT-II: Descriptive Statistics

Measures of central tendency, Introduction to Probability, Probability Distributions, Sampling and Sampling Distribution, Distribution of Sample Means, population, Measures of location of dispersions.

UNIT-III: Basic analysis techniques

Statistical hypothesis generation and testing, Hypothesis testing with two sample test Errors in Hypothesis Testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test.

UNIT-IV: Data Analysis techniques

Data analysis techniques: Regression analysis, Classification techniques, Clustering, Association rules analysis, Measures of attribute selection, Confusion

matrix and ROC, Different Plots (Line Plot, Bar Chart, Histogram Plot, Box and Whisker Plot, Scatter Plot.).

UNIT-V: Case studies and projects

Understanding business scenarios, Feature engineering and visualization, Scalable and parallel with Hadoop and Map-Reduce, Sensitivity Analysis.

Text book:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer.
2. V. K. Jain "Data Science and Analytics".

References book:

1. Mize Edward "Data Analytics".
2. Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill Publishing.
4. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", 2nd Edition, Elsevier.

CO-PO&PSO Correlation

Course Name: Fundamental of Data Analytics								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**2**					**1**		**1**
CO2:		**2**					**1**	**1**
CO3:	**2**	**2**	**1**					
CO4:	**2**					**1**	**1**	**1**
CO5:		**2**			**1**	**1**	**2**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**I**
Name of the Course:		**Data Mining & Data Warehousing**	**Course Code:**		**SOE-M-CSE104**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

This course provides the student with in depth knowledge of Data Warehousing principles, Data Warehouse techniques, and Business Intelligence systems. The course introduces the topics of Data Warehouse design, Extract-Transform-Load (ETL), Data Cubes, and Data Marts. Students will create Business Intelligence using Data Warehouses with several OLAP and analytical tools.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand fundamentals of data mining and Data warehousing techniques
CO2	Understand and apply data preprocessing techniques for data consistency
CO3	Understand features and their selection and reduction
CO4	Understand different algorithms for data mining
CO5	Understand and apply classification algorithm for classification of data

Syllabus:

UNIT–I: Introduction

Introduction to Data Science, data mining, machine learning, target applications, Knowledge Discovery, Data Mining Functionalities, Data Mining Techniques, Data Mining System categorization and its Issues.

Mathematical Background: Mean, Median, mode, standard deviation, correlation, covariance, likelihood, data: nominal, ordinal, ratio, interval, factor, levels. Interquartile range, Sampling, probability.

UNIT–II: Data Pre-processing

Data Cleaning, Data Integration and Transformation: standardization, normalization, smoothing, aggregation, generalization. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Discretization and Concept, encoding and decoding, Representing input data and output knowledge Visualization techniques, Guidelines for Successful Data Mining.

UNIT–III: Features

Introduction, importance, selection, extraction engineering Dimensionality Reduction: Principal Components Analysis, Sketching PCA, Applying PCA, Limitations of PCA.

UNIT–IV: Association Analysis

Basic Concepts and Algorithms, Problem Definition, Frequent Item set Generation, Rule Generation, Interesting measures: support and confidence, Apriori Algorithms, Improving the efficiency of the Apriori Algorithm, Tree Based Algorithms etc.

UNIT–V: Classification

Basic Concepts, linear vs nonlinear, Multiclass, class imbalance, Model Overfitting, linear classifier with examples, measuring classifier accuracy, clustering techniques.

Text Books:

1. J. Han & M. Kamber, "Data Mining: Concepts and Techniques", 2nd Ed, 2006.
2. Arun K Pujari "Data Mining Techniques", University Press.

Reference Books:

1. W. H. Inmon, "Building the Data Warehouse", 3rd edition.
2. Anahory and Murray, Data warehousing in the real world, Pearson Education/Addison Wesley.
3. Margaret Dunham, "Data Mining: Introductory and Advanced Topics", Prentice Hall.

CO-PO & PSO Correlation

Course Name: Data Mining & Data Warehousing								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**					**1**	**2**	**1**
CO2:	**2**		**3**					**1**
CO3:		**2**					**2**	
CO4:	**2**	**3**				**1**	**1**	**1**
CO5:	**2**	**2**						**1**

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**I**
Name of the Course:		**Software Engineering**	**Course Code:**		**SOE-M-CSE105(1)**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

This course introduces the concepts and methods required for the construction of software interactive system. It will also include quality measures and maintenance of software. It also focuses on the Reliability Techniques for software development.

Course Outcomes:

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

CO Number	Course Outcome
CO1	Understand the issues affecting the organization, planning and control of software based system development.
CO2	Analyze and design of a small software intensive system.
CO3	Manage risk and measure the software quality and reliability.

Syllabus:

UNIT–I:

Introduction, software life-cycle models, CMMI

UNIT-II:

SRS, SDS, formal requirements specification and verification - axiomatic and algebraic specifications Requirement Engineering Processes.

UNIT-III:

Software Design: UML; computer-aided software engineering (CASE), Verification and Validation: Software Testing, Quality assurance, Maintenance.

UNIT–IV:

Project Management: activities, planning, scheduling, Risk Management.

UNIT–V:

Reliability Techniques, Models of concurrency, Static analysis, Security vulnerabilities/attacks, Vulnerability detection.

Text Books:

1. Sommerville "Software Engineering, Pearson Education Publication", 7th edition.
2. M.Ben-Ari "Principles of concurrent and distributed programming", Addison-Wesley, 2006 "Handbook of model checking", Springer, 2014.

Reference Books:

1. R. S. Pressman: Software Engineering: A Practiioners Approach, 5th Edn., TMA, New Delhi.
2. M. Ben-Ari, "Principles of concurrent and distributed programming", Addison-Wesley, 2006 "Handbook of model checking", Springer, 2014.
3. Brian Chess and Jacob West, "Secure programming with static analysis", Addison Wesley, 2007 Additional research papers.

CO-PO&PSO Correlation

Course Name: Software Engineering								
	Program Outcomes					PSOs		
Course	**1**	**2**	**3**	**4**	**5**	**1**	**2**	
CO1:	**1**					**2**		**1**
CO2:		**1**	**1**	**1**	**1**		**1**	
CO3:		**1**		**1**				**2**

Note: 1.: Low 2.: Moderate 3.: High

Programme	:	**M. Tech.**	**Semester**	:	**I**
Name of the Course	:	**IoT Technology & Applications**	**Course Code:**		**SOE-M-CSE105(2)**
Credits	:	**3**	**No of Hours**	:	**3 Hrs./week**
Max Marks	:	**100**			

Course Description:

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand the vision of IoT from a global context.
CO2	Determine the Market perspective of IoT.
CO3	Building state of the art architecture in IoT.
CO4	Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.
CO5	Understand different IoT tools and its implementation.

Syllabus:

UNIT-I: IoT & Web Technology

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT-II: M2M to IoT – A Basic 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: IoT Architecture-State of the Art

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

UNIT-IV: IoT Applications for Value Creations

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT-V: IoT Privacy, Security, Governance & IoT solutions

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security & privacy issues in IoT

Developing IoT Solutions

Introduction to Python, Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi Implementation of IoT with Arduino and Raspberry, Cloud Computing, Fog Computing, Connected Vehicles.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013

Reference Books:

1. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

CO-PO & PSO Correlation

Course Name: IoT Technology & Applications								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1	2	3			1	2	3
CO2:	2	1				1	2	1
CO3:	2						1	1
CO4:	2	2					2	
CO5:	2	2				1	1	1

Note: 1: Low 2.: Moderate 3: High

Programme	:	**M. Tech.**	**Semester**	:	**I**
Name of the Course	:	**Big Data & Cloud Computing**	**Course Code:**		**SOE-M-CSE105(3)**
Credits	:	**3**	**No of Hours**	:	**3 Hrs./week**
Max Marks	:	**100**			

Course Description:

This course is designed to introduce the concepts of Cloud Computing and Big Data as a new computing paradigm. The course will expose students to different views of understanding the Cloud Computing and Big Data such as theoretical, technical and commercial aspects.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Differentiate different computing techniques
CO2	Compare various cloud computing providers/ Software.
CO3	Identify the appropriate cloud services for a given application
CO4	Compare various cloud computing providers/ Software.
CO5	Handle Open-Source Cloud Implementation and Administration.
CO6	Analyze authentication, confidentiality and privacy issues in Cloud computing environment.

Syllabus:

UNIT-I: Introduction of Computing

New Computing Paradigms & Services: Cloud computing - Edge computing, Grid computing - Utility computing - Cloud Computing Architectural Framework, Cloud Deployment Models - Virtualization in Cloud Computing, Parallelization in Cloud Computing, Security for Cloud Computing - Cloud Economics.

UNIT-II: Big Data

Introduction, Challenges, 5 V's- Ecosystem- Google's Solution Vs Hadoop- Hadoop: Ecosystem, Architecture- Cluster; Map Reduce- Information retrieval through Map Reduce- Hadoop File System, GFS- Page Ranking using Map Reduce.

UNIT-III: Big Data Analytics

Classification of analytics - Data Science - Terminologies in Big Data - CAP Theorem - BASE Concept. NoSQL: Types of Databases – Advantages – NewSQL - SQL vs. NOSQL vs NewSQL. Linear Regression

UNIT-IV: No SQL Databases

Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export. Cassandra: Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

UNIT-V:

Case study- Apache Spark, Machine Learning, VMware.

Text Books:

1. EMC Education Services "Data Science and Big Data Analytics"
2. Viktor Mayer-Schonberger, Kenneth Cukier "Big Data"

Reference Books:

1. Subhashini Chellappan Seema Acharya "Big Data and Analytics"
2. George Reese "Cloud Application Architectures", O'Reillly Publications

CO-PO&PSO Correlation

Course Name: Big Data & Cloud Computing								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1	2	3	4	5	1	2	3
CO2:	2	1				1	2	1
CO3:	2		2				1	1
CO4:	1	2					2	
CO5:	2	2	2			1	1	1
CO6:	1	2				2	1	2

Note: 1: Low 2.: Moderate 3: High

Programme	:	**M. Tech.**	**Semester**	:	**I**
Name of the Course	:	**Data Structures and Algorithm Lab**	**Course Code:**		**SOE-M-CSE106**
Credits	:	**2**	**No of Hours**	:	**4 Hrs./week**
Max Marks	:	**50**			

Course Description:
In this course the student will have the opportunity to supplement the theory subject by writing actual programs in the C language during laboratory sessions.

Course Outcomes:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Implement and compare correctness of algorithms using inductive proofs and invariants.
CO2	Implement and Analyse worst-case running times of algorithms using asymptotic analysis.
CO3	Implement and compare different divide-and-conquer algorithms
CO4	Implement and analyses dynamic-programming algorithms
CO5	Implement and compare different greedy algorithms

The following concepts will be covered in the lab:

- Implementation of Sorting algorithm like Quick sort, Heap Sort, Merge sort etc. and computation of its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator.
- Implementation of divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.
- Implementation of ,0/1 Knapsack problem using (a) Dynamic Programming method (b) Greedy method.
- Implementation of Dijkstra's algorithm to find shortest paths from a given vertex in a weighted connected graph.
- Implementation of finding Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
- Implementation of Prim's algorithm to find Minimum Cost Spanning Tree of a given connected undirected graph.
- Implementation of All-Pairs Shortest Paths problem using Floyd's algorithm.
- Implementation of Travelling Sales Person problem using Dynamic programming.
- Implementation of finding all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

Text Books:

- Alfred. V. Aho, John. E. Hopcroft, Jeffrey. D. Ullman, & quot; Data Structures and Algorithms, Addison-Wesley Publications., 1985.

Reference Books:

- M. T. Goodrich and R. Tomassia, John Wiley and sons "Algorithm Design: Foundations, Analysis and Internet examples"
- S. Sridhar "Design and Analysis of Algorithms", Oxford Univ. Press.
- Aho, Ullman and Hopcroft "Design and Analysis of algorithms", Pearson Education.

CO-PO&PSO Correlation

Course Name: Data Structures and Algorithm Lab								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1	1	2			1	1	2
CO2:	2	2	2			2	2	2
CO3:	1	2	1					1
CO4:	1	2	1			1		
CO5:	1	2	2			1	1	1

Note: 1: Low 2.: Moderate 3: High

Programme	:	**M. Tech.**	**Semester**	:	**I**
Name of the Course	:	**Data Mining and Data Warehousing Lab**	**Course Code:**		**SOE-M-CSE107**
Credits	:	**2**	**No of Hours**	:	**4 Hrs./week**
Max Marks	:	**50**			

Course Description:

In this course students will implement the Data Warehouse techniques, and Business Intelligence systems. The concepts of Data Warehouse design and Business Intelligence using Data Warehouses with several OLAP and analytical tools will be explored.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Design and evaluate the different models of OLAP
CO2	Implement various algorithms used in information analysis of Data Mining Techniques
CO3	Design and evaluate the different techniques for data pre-processing.
CO4	Implement Knowledge retrieval using data mining techniques
CO5	Implement classification models using datasets

The following concepts will be covered in the lab:

- Explore machine learning tool "WEKA"
  - Explore WEKA Data Mining/Machine Learning Toolkit Downloading and/or installation of WEKA data mining toolkit, Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface. Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, classify panel, Cluster panel, Associate panel and Visualize panel)
  - Study the arff file format Explore the available data sets in WEKA. Load a data set (ex. Weather dataset, Iris dataset, etc.) Load each dataset and observe the following:
    - List the attribute names and they types Number of records in each dataset
    - Identify the class attribute (if any).
    - Plot Histogram Determine the number of records for each class. Visualize the data in various dimensions.
- Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

- Explore various options available in Weka for preprocessing data and apply unsupervised filters like Discretization, Resample filter, etc. on each dataset.
- Load weather. nominal, Iris, Glass datasets into Weka and run Apriori algorithm with different support and confidence values. Study the rules generated.

- Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated. Derive interesting insights and observe the effect of discretization in the rule generation process.

1. Demonstrate performing classification on data sets Load each dataset into Weka and run 1d3, J48 classification algorithm.
   - Study the classifier output. Compute entropy values, Kappa statistic.
   - Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix.
   - Load each dataset into Weka and perform Naïve-bayes classification and k-Nearest Neighbor classification. Interpret the results obtained.
   - Plot RoC Curves Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.
2. Demonstrate performing clustering of data sets Load each dataset into Weka and run simple k-means clustering algorithm with different values of k (number of desired clusters).
   - Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
   - Explore other clustering techniques available in Weka.
   - Explore visualization features of Weka to visualize the clusters.
   - Derive interesting insights and explain.
3. Demonstrate knowledge flow application on data sets
   - Develop a knowledge flow layout for finding strong association rules by using Apriority.
   - FP Growth Algorithms Set up the knowledge flow to load an ARFF (batch mode) and perform a cross validation using J48 algorithm.
   - Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree.

Text Books:

- P. Adriaans & D. Zantinge, Data Mining, Addison Wesley, 1996.
- R. Mattison, Data Warehousing: Strategies, Tools and Techniques, McGraw Hill, 1996.
- P. Ponniah, Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Wiley, 2001.
- Soman K P, “Insight into Data Mining: Theory & Practice”, Prentice hall of India
- M.H. Dunham, “Data Mining Introductory and Advanced Topics”, Pearson

Education.
- Ralph Kimball, "The Data Warehouse Lifecycle toolkit", John Wiley.

CO-PO & PSO Correlation

Course Name: Data Mining and Data Warehousing Lab								
	Program Outcomes					PSOs		
Course	1	2	3	4	5	1	2	
CO1:	3	2	1			3		
CO2:		2	1		1			2
CO3:	2	2	2		1		1	2
CO4:	2	2	2		1		1	1
CO5	3	1	2			1		1

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**I**
Name of the Course:		**Fundamental of Data Analytics Lab**	**Course Code:**		**SOE-M-CSE108**
Credits	**:**	**2**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**50**			

Course Descriptions:

This course will cover implementation of fundamental algorithms and techniques used in Data Analytics.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Find a meaningful pattern in data
CO2	Implement and analyze Graphically interpret data
CO3	Implement the analytic algorithms
CO4	Analyze large scale analytics projects from various domains
CO5	Design intelligent decision support systems

The following concepts will be covered in the lab:

- Text classification.
- Preprocessing techniques
- Designing tools to remove stop words in dictionary
- Designing of training and testing data set for text classification
- Machine learning based sentiment analysis.

Text Books:

- Breck Baldwin, ―Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
- Richard M Reese, ―Natural Language Processing with Java‖, O_Reilly Media, 2015.
- Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
- Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval‖, Oxford University Press, 2008.

CO-PO&PSO Correlation

Course Name: Fundamental of Data Analytics Lab								
	Program Outcomes					PSOs		
Course	1	2	3	4	5	1	2	3
CO1:	1	1				1		
CO2:	3	3			1		1	1
CO3:	2	1			1	1	2	
CO4:	2	2			1	1	2	1
CO5:	2	2			1	1	2	1

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M.Tech.**	**Semester :**	**I**
Name of the Course:		**Software Engineering Lab**	**Course Code:**	**SOE-M-CSE109(1)**
Credits	**:**	**2**	**No of Hours :**	**4 Hrs/Week**
Max Marks	**:**	**50**		

Course Descriptions:
This lab deals with the analysis and design of a software problem. The tool used in a lab is rational rose. this tool is used for an object oriented design of a problem. We draw a UML diagram in a rational rose which deals with the objects and classes in a system. The Unified Modeling Language or UML is a mostly graphical modelling language that is used to express designs. It is a standardized language in which to specify the artefacts and components of a software system. It is important to understand that the UML describes a notation and not a process. It does not put forth a single method or process of design, but rather is a standardized tool that can be used in a design process.

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

CO Number	Course Outcome
CO1	Provide users with a ready-to-use, expressive visual modeling language so they can develop and exchange meaningful models
CO2	Ability to generate a high-level design of the system from the software requirements
CO3	Will have experience and/or awareness of testing problems and will be able to develop a simple testing report
CO4	Ability to translate end-user requirements into system and software requirements

The following concepts will be covered in the lab:

1. **Introduction to Software Engineering-LAB.**
2. **Data flow diagram:**
   - **a.** What processes make up a system?
   - **b.** What data are used in each process?

   c. What data are stored?
   d. What data enter and leave the system?

3. **Sample Design:**
   a. Class Diagram
   b. Sequence Diagram
   c. State Chart Diagram
   d. Use-Case Diagram
4. **Project**:
   a. Write down the problem statement for a suggested system of relevance.
   b. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
   c. Perform the Data Flow Diagram (DFD).
   d. Performa the Sequence Diagram.
   e. Perform the State Chart Diagram.
   f. Perform The Use-Case Diagram.
   g. Perform the ER Diagram (If Database applicable).
   h. Prepare time line chart/Gantt Chart/PERT Chart for selected project.

Text Books :

- The unified modeling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education, 2nd Edition, 2005.

CO-PO & PSO Correlation

Course Name: Software Engineering Lab												
	Program Outcomes								PSOs			
Course Outcomes	1	2	3	4	5	6	7	8	1	2	3	4
CO1:	1	3	1			1			2	2	1	1
CO2:	1	2							1		1	
CO3:	2	2				1			1		1	
CO4:	1	2	1			2			1	2	2	2

Note: 1.: Low 2.: Moderate 3.: High

Programme	:	**M. Tech**	**Semester**	:	**I**
Name of the Course	:	**IoT Technology and Applications Lab**	**Course Code:**		**SOE-M-CSE109(2)**
Credits	:	**2**	**No of Hours**	:	**4 Hrs. / Week**
Max Marks	:	**50**			

Course Descriptions:

This course will describe the market around the Internet of Things (IoT), the technology used to build these kinds of devices, how they communicate, how they store data, and the kinds of distributed systems needed to support them. Divided into four modules, we will learn by doing. We will start with simple examples and integrate the techniques we learn into a class project in which we design and build an actual IoT system. The client will run in an emulated ARM environment, communicating using common IoT protocols with a cloud enabled backend system.

Course Outcomes:

CO Number	Course Outcome
CO1	Understand the importance of internet of things in present scenario
CO2	Describe the interfacing of IoT with arduino.
CO3	Design of direct and alternating type of electrical instruments using Arduino.
CO4	Analyze the protection schemes of induction motor against over current and under voltage.

The following concepts will be covered in the lab:

Design a Digital DC Voltmeter and Ammeter to measure the voltage and current in DC electrical circuits using Arduino and display the values in LCD display, design a Digital AC Voltmeter and Ammeter to measure the voltage and current in AC electrical circuits using Arduino and display the values in LCD display, Digital frequency meter to measure the frequency in any AC electrical circuit using Arduino and display the values in LCD display, Measure the power and energy in electrical circuit using Arduino and display the values in LCD display, Measure the phase shift and power factor in an electrical circuit for different loads using Arduino and display the value in LCD display, Design an over current relay for distribution system and displaying the tripping status of the relay in substation through IOT, Design a system to protect home appliances from over and under voltages using Arduino, Design a system for protecting the three phase induction motor from over voltages, over currents, temperature and displaying the status of the motor at remote location using IOT, Design a traffic control system using IOT.

Additional Experiments

Design a railway gate control using stepper motor using IOT, Control the speed and direction of a DC motor using Arduino and display the status of the motor at the remote location using IOT.

Reference Books:

- Mark torvalds, "Arduino Programming: Step-by-step guide to mastering arduino hardware and software (Arduino, Arduino projects, Arduinouno, Arduino starter kit, Arduino ide, Arduinoyun, Arduino mega, Arduinonano) Kindle", 2nd Edition, 2001
- Michael J Pont, "Embedded C", 2nd Edition, Pearson Education, 2008.

CO-PO & PSO Correlation

Course Name: Internet of Things (IoT) Lab								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	1	1	1	2		1	2	2
CO2:	2	2	2	3		2	2	2
CO3:	1		2			1		3
CO4:	1						1	2

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M.Tech.**	**Semester :**	**I**
Name of the Course:		**Big Data and Cloud Computing Lab**	**Course Code:**	**SOE-M-CSE109(3)**
Credits	**:**	**2**	**No of Hours :**	**4 Hrs/Week**
Max Marks	**:**	**50**		

Course Descriptions:
Configure various virtualization tools such as Virtual Box, VMware workstation. Design and deploy a web application in a PaaS environment. Learn how to simulate a cloud environment to implement new schedulers. Install and use a generic cloud environment that can be used as a private cloud. Manipulate large data sets in a parallel environment.

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

CO Number	Course Outcome
CO1	Configure various virtualization tools such as Virtual Box, VMware workstation.
CO2	Design and deploy a web application in a PaaS environment.
CO3	Learn how to simulate a cloud environment to implement new schedulers.
CO4	Install and use a generic cloud environment that can be used as a private cloud.

The following concepts will be covered in the lab:

- Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
- Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
- Install Google App Engine. Create hello world app and other simple web applications using python/java.
- Use GAE launcher to launch the web applications.
- Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

- Find a procedure to transfer the files from one virtual machine to another virtual machine.
- Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
- Install Hadoop single node cluster and run simple applications like wordcount.

Text Books:

- Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
- John W. itinghouse james F.Ransome, "Cloud Computing Implementation, Management and Security", CRC Press.

Reference Books:

- Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
- Cloud Security: A Comprehensive Guide to secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley

CO-PO & PSO Correlation

Course Name : Big Data and Cloud Computing Lab												
	Program Outcomes								PSOs			
Course Outcomes	1	2	3	4	5	6	7	8	1	2	3	4
CO1:	1								3			
CO2:		3	1		1						3	1
CO3:		3			1					1	2	
CO4:	1	3			1					1	2	

Note: 1.: Low 2.: Moderate 3.: High

Scheme & Syllabus of M. Tech (CSE) Programme

Semester II

S. No	Subject Code	Subject	Periods Per Week			Scheme of Examination and Marks				Credit L+[T+P]/2
						PRE**		ESE*	Total Marks	
			L	T	P	Mid Sem	TA			
1.	SOE-M-CSE201	Next Generation Databases	3	0	0	30	20	50	100	3
2.	SOE-M-CSE202	Business Intelligent & Machine learning	3	0	0	30	20	50	100	3
3.	SOE-M-CSE211(X)	Elective II	3	0	0	30	20	50	100	3
4.	SOE-M-CSE213(X)	Elective III	3	0	0	30	20	50	100	3
5.	SOE-M-CSE210	Research Methodology	3	0	0	30	20	50	100	3
6.	SOE-M-CSE212(X)	Elective Lab II	0	0	4	0	30	20	50	2
7.	SOE-M-CSE207	Next Generation Databases Lab	0	0	4	0	30	20	50	2
8.	SOE-M-CSE208	Business Intelligent & Machine learning Lab	0	0	4	0	30	20	50	2
9.	SOE-M-CSE214(X)	Elective Lab III	0	0	4	0	30	20	50	2
Total			15	0	16	150	220	330	700	23

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Elective-II

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE211(1)	Signal Processing and Data Analytics
2.	SOE-M-CSE211(2)	Digital Image Processing
3.	SOE-M-CSE211(3)	Blockchain Fundamentals and Applications

Elective-III

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE213(1)	Information Retrieval
2.	SOE-M-CSE213(2)	Soft Computing
3.	SOE-M-CSE213(3)	Wireless Sensor Network and IoT

Elective Lab - II

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE212(1)	Signal Processing and Data Analytics Lab
2.	SOE-M-CSE212(2)	Digital Image Processing Lab
3.	SOE-M-CSE212(3)	Blockchain Fundamentals and Applications Lab

Elective Lab - III

Sl. No	Subject Code	Subject Name
1.	SOE-M-CSE214(1)	Information Retrieval Lab
2.	SOE-M-CSE214(2)	Soft Computing Lab
3.	SOE-M-CSE214(3)	Wireless Sensor Network and IoT Lab

Programme	:	**M. Tech.**	**Semester**	:	**II**
Name of the Course	:	**Next Generation Databases**	**Course Code:**		**SOE-M-CSE201**
Credits	:	**3**	**No of Hours**	:	**3 Hrs./week**
Max Marks	:	**100**			

Course Description:

This course offers lecture, laboratory, and online interaction to provide a foundation in next generation data management concepts and database systems. It includes key concepts on parallel, distributed, NoSQL, Blockchain and Quantum Databases. It also convers next generation database query languages like GenoMetric Query Language (GMQL), NOSQL Query Language, xQuery, GraphQL, PartiQL, N1QL. This further explains concepts of advance database administration tools and security threats and strategies to protect data and database systems.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Explain about Database Revolutions.
CO2	Explain about various Document database, its types and features.
CO3	Work with various next generation database query languages.
CO4	Get familiar with Distributed Database Patterns. It's consistency model, Data Model and storage.

Syllabus:

UNIT-I: Introduction to Parallel and Distributed databases

Limitations of Traditional Databases, Tradition Databases vs Next Generation Databases, Parallel databases: key concepts, Architecture, Parallelizing Individual operations, Parallel query Evaluation, Distributed Databases: key concepts, Architecture, Distributed Data storage, Distributed catalog, Distributed query processing Distributed concurrency control and recovery, Transaction Processing.

UNIT-II: NoSQL Databases

Introduction to NoSQL, Object database, Key–value database, Document-oriented database and XML database, Graph database, Multivalue databases, Multimodal database

UNIT-III: Next Generation Query Languages

Introduction to Advance and Next Generation Query Languages, SQL/JRT, SQL CLR, GenoMetric Query Language (GMQL), NOSQL Query Language, xQuery, GraphQL, PartiQL, N1QL

UNIT-IV: Blockchain and Quantum Ledger Database (QLDB)

Blockchain: Introduction, key concepts, Ledger structure, Blockchain-based databases, Quantum: Introduction, key concepts, Quantum Databases, Quantum Ledger Database

UNIT-V: Next Generation Database Administration and Security Issues

Next Generation Database Administration: Key Concepts, Administration Tools, PaaS and IaaS database administrations, next generation security issues and trends, attack vectors and database security approaches.

Text Books:

- Distributed Databases, Stefano Ceri, McGraw-Hill Education, 2017.
- NoSQL for Dummies, Adam Fowler, Wiley, 2015.
- Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008
- Chellammal Surianarayanan, Kavita Saini, Pethuru Raj, Blockchain Technology and Applications, CRC Press, 2020
- Joseph Steinberg, Cybersecurity for Dummies, Wiley, 2019

References Books:

- Principles of Distributed Database Systems by Ozsu, Ozsu M. Tamer, Pearson Education, 2006.
- NoSQL Database for Storage and Retrieval of Data in Cloud, Ganesh Chandra Deka, CRC Press, 2017
- Tiana Laurence, Introduction to Blockchain Technology the Many Faces of Blockchain Technology in the 21st Century, Van Haren Publishing
- Mayank Bhushan, Rajkumar Singh Rathore, Aatif Jamshed, Fundamentals of Cyber Security, BPB Publications, 2017.

CO-PO&PSO Correlation

Course Name: Next Generation Databases								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2	2				1	2	1
CO2:		3					1	1
CO3:	1	2	2				2	
CO4:	2	2				1	1	1

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**II**
Name of the Course:		**Business Intelligent & Machine Learning**	**Course Code:**		**SOE-M-CSE202**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Descriptions:

This course gives the fundamental description about Business Intelligence and technique for gathering, storing, analyzing, sharing and providing access to data, to help University Enterprise or any other organization to make a better decision. Also understand the fundamental concepts in machine learning and popular machine learning algorithms.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Learn concept, process, and practice of the data science and how methodologies are applied to visualize information from raw data.
CO2	Learn BI involving predictive and statistical approach.
CO3	Implement BI techniques by using various tools and Create data visualization.
CO4	Implement and apply machine learning algorithms.
CO5	Select appropriate algorithms for solving a particular group of real-world problems.
CO6	Select real-world applications that needs machine learning based solutions.

Syllabus:

UNIT-I: Introduction to Business Intelligence (BI)

(BI concept, BI architecture, BI in today's perspective, BI Process, Applications of BI like Financial analysis, statistical analysis, sales analysis, CRM, result pattern and ranking analysis, Balanced Scorecard, BI in Decision Modelling: Optimization, Decision making under uncertainty. Ethics and business intelligence).

Data Visualization and Dashboard Design: (Responsibilities of BI analysts by focusing on creating data visualizations and dashboards, Importance of data visualization, types of basic and composite charts).

UNIT-II: Performance Dashboard:

(Measuring, Monitoring and management of Business, KPIs and dashboard, the types of dashboards, the common characteristics of Enterprise dashboard, design of enterprise dashboards, and the common pitfalls of dashboard design).

Modelling and Analysis: (Exploring Excel Modeling capabilities to solve business problems, summarize and present selected data, introduction to business metrics and KPIs, creating cubes using Microsoft Excel).

Future of Business Intelligence: (Emerging Technologies, Predicting the Future with the help of Data Analysis, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology).

UNIT-III:

Foundations for Machine Learning (ML), Supervised Learning: Classification (Artificial Neural Network, classifying with K-Nearest Neighbors, splitting datasets one feature at a time: Decision Trees, classifying with probability theory: Naive Bayes, Support Vector Machines, Improving classification with the AdaBoost meta algorithm), Regression (Linear Regression, Logistic Regression).

UNIT-IV: Unsupervised Learning

Clustering (Grouping unlabeled items using k-means clustering, Hierarchical Clustering, Density based Clustering - DBScan), Association (Association analysis with the Apriori algorithm), Efficiently finding frequent item sets with FP-growth. Reinforcement learning: Markov decision process (MDP), Bellman equations, Linear quadratic regulation (LQR), Linear Quadratic Gaussian (LQG), Dimensionality reduction.

UNIT-V: Case study:

BI (curriculum data extraction lattes for the institution of higher education, Creating a BI Strategy for an Emergency Healthcare Company). ML (Scaling image processing used in roof inspections, Digitizing information on business cards, Building an automated category tree).

Text Books:

- Efraim Turban, Ramesh Sharda, Dursun Delen, “Decision Support and Business Intelligence Systems”, Pearson.
- Tom Mitchel, Machine Learning, McGraw Hill.

Reference Books:

- Hans-Georg Kemper and Henning Baars “Business Intelligence – Grundlagen und praktische Anwendungen: Eine Einführung in die IT”.
- David Loshin Morgan, Kaufman, “Business Intelligence: The Savvy Manager‟s Guide”, Second Edition.
- Harrington, Peter. Machine learning in action. Manning Publications Co.

- Bishop, C. M., "Pattern recognition and machine learning", New York: springer.

CO-PO&PSO Correlation

Course Name: Business Intelligent & Machine Learning								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**					**1**	**2**	**1**
CO2:	**2**		**2**				**1**	**1**
CO3:	**2**	**2**					**2**	
CO4:		**2**				**1**	**1**	**1**
CO5:	**2**	**2**				**1**	**2**	**1**
CO6:	**2**	**1**				**2**	**1**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme	:	**M. Tech.**	**Semester**	:	**II**
Name of the Course	:	**Signal Processing and Data Analytics**	**Course Code:**		**SOE-M-CSE211(1)**
Credits	:	**3**	**No of Hours**	:	**3 Hrs./week**
Max Marks	:	**100**			

Course Description:

The course will provide foundational knowledge of digital signal processing and data analytics and get practical experience in building projects in analyzing signals. It does not require an extensive math background to signals and data analytics. It introduces basic concepts of signal processing and data analytics.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Learn concept, process, and practice of the digital signal processing and data analytics.
CO2	Learn digital signal processing to analyze signals.
CO3	Learn data analytics techniques to deep understand of signals
CO4	Learn techniques to detect and classify digital signals.
CO5	Design and analyze data using different statistical tools

Syllabus:

UNIT-I: Introduction to Signal Processing

Signals, systems and signal processing, classification of signals, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, Periodic Sampling, Frequency domain representation of sampling, Reconstructions of band limited signals from its samples.

UNIT-II: Introduction to Fourier Domain

Representation of Periodic sequences: The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT.

UNIT-III: Introduction to data analytics

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT-IV: Data analytics techniques

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – interquartile range – variability for qualitative and ranked data

UNIT-V: Data analytics tools to analyze data

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean

Text Books:

- David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
- Digital Signal Processing: A Computer-Based Approach, S. K. Mitra, McGraw-Hill, Third edition, 2006.

Reference Books:

- Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
- Digital Signal Processing fundamentals and Applications, Li Tan, Jean Jiang, Academic Press,2nd edition,2013

CO-PO&PSO Correlation

Course Name: Signal Processing and Data Analytics								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2	1				1	2	1
CO2:	2						1	1
CO3:	2	2					2	
CO4:	2	2				1	1	1
CO5:	1	2				1	2	1

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**II**
Name of the Course:		**Digital Image Processing**	**Course Code:**		**SOE-M-CSE211(2)**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

The objective of this course to equip the students with the techniques & tools for digital image processing, & image analysis in the form of image segmentation, image enhancement, image filters, image transforms, Fourier transforms & fast Fourier transforms, edge detection, image segmentation & colour imaging.

Course Outcomes:

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

CO Number	Course Outcome
CO1	Describe the theory and algorithms that are widely used in digital image processing
CO2	Apply a proper image enhancement technique for given a set of noisy images
CO3	Compare different image segmentation and compression techniques
CO4	Formulate solutions using morphological concepts
CO5	Develop any application using different image processing techniques

Syllabus:

Unit 1: Digital Image Fundamental

Introduction – Steps in Digital Image Processing, Components, Elements of Visual Perception, Light and Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels.

Unit 2: 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.

Unit 3: Image Restoration

Noise models, Mean filters, Order Statistics, Adaptive filters, Band reject, Band pass, Notch – Optimum notch filtering, Inverse Filtering, Constrained Least Square Filtering, Wiener filtering.

Unit 4: Image Compression

Fundamentals – Image Compression models, Error Free Compression, Variable Length Coding – Bit, Plane Coding, Lossless Predictive Coding, Lossy Compression, Lossy Predictive Coding, Wavelet Coding, and Compression Standards – JPEG2000.

Unit 5: Image Segmentation & Representation

Segmentation – Detection of Discontinuities, Edge Linking and Boundary detection, Region based segmentation, Representation – Boundary descriptors, Simple Descriptors, Shape numbers, Regional descriptors, Simple and Topological Descriptors, Introduction to Image Processing Toolbox, Practice of Image Processing Toolbox, and Case studies–Various Image Processing Techniques.

Text Books:

- Digital Image Processing. Gonzales R. C. & Woods R. E. 3rd Ed., Pearson Education.2010.
- Fundamentals of Digital Image Processing. Jain A. PHI Learning Pvt. Ltd., 2011.
- Digital Image Processing. Jayaraman S., Esaki R. S., Kumar T. V., 2nd Ed., Tata McGraw Hill Pvt. Ltd, 2010.
- Digital Image Processing Using MATLAB. Gonzalez R. C., Woods R. E., Eddins S. L., 3rd Ed. Tata McGraw Hill Pvt. Ltd, 2011.

Reference Books:

- Digital Image Processing and analysis, Chanda B., Majumder D. D. PHI Learning Pvt. Ltd., 2011.
- Digital Image Processing and Pattern Recognition, Pakhira M. K., 2nd Ed., Tata McGraw Hill Pvt. Ltd, 2010.
- Fundamentals of Digital Image Processing, Annadurai S., Shanmugalakshmi R., 1st Ed. Pearson Education, 2007.

CO-PO&PSO Correlation

Course Name: Digital Image Processing								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2	2				1		
CO2:	3	1					1	
CO3:	2	2	2			1		1
CO4:	2	2	3				1	
CO5	2	2	3					

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**II**
Name of the Course:		**Blockchain Fundamentals and Applications**	**Course Code:**		**SOE-M-CSE211(3)**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Description

Explore the core concepts of blockchain technology, including distributed ledger, consensus mechanisms, and smart contracts. Discover real-world applications in finance, supply chain, healthcare, and more. Address regulatory considerations and challenges. Gain the knowledge to identify use cases and contribute to blockchain projects. Suitable for professionals seeking to leverage the transformative potential of blockchain.

Course Outcomes:

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

CO Number	Course Outcome
CO1	have knowledge about the design principles of blockchain and smart contracts.
CO2	be able to program and demonstrate the working of different consensus mechanisms.
CO3	be able to deploy and interact with blockchain systems by setting up a system and sending and reading the transactions.
CO4	be able to design, build, and deploy distributed applications and smart contracts by identifying the need of blockchains to find the solution to the real-world problems.
CO5	be able to evaluate security, privacy, and efficiency of a given blockchain use case.

Syllabus:

Unit-I: Introduction

Introduction to Blockchain and Digital Currency, Evolution, Blockchain as Public ledger, Structure of a Block, Transactions, Merkel Trees, Peer-to-Peer Networks, Timestamp, Double Spend Problem, Decentralization Applications, Characteristics, Benefits and Challenges.

Unit-II: Cryptography In Blockchain

Hash Functions, Public Key Cryptosystem, Public Key Generation, Digital Signature, Zero-Knowledge Proof, k-Anonymity.

Unit-III: Smart Contracts And Consensus Algorithms

Smart Contract, Applications of Smart Contracts, Mining, Hardness of Mining, Incentive, Consensus, Paxos, Consensus Algorithms - PBFT, PoW, PoS, etc.

Unit-IV: Ethereum And Hyperledger

Ethereum, Trustlessness and Immutability of Blockchain Technology, Proof of Work (PoW) and Proof of Stake (PoS), Ethereum Virtual Machine (EVM), Wallets for Ethereum, Solidity, Hyperledger, Corda, Hyperledger Fabric, Hyperledger Composer, Permissioned vs Permissionless Blockchain.

Unit-V: Blockchain For Real-World Applications

Cryptocurrencies, Banking, Supply Chain, Healthcare, Real-Estate, Judiciary, IoT, Insurance, etc.

Text Books:

- Arvind Narayanan, Joseph Bonneau, Edward Felten, andrew Miller, Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive introduction”, Princeton University Press, 2016.
- Roger Wattenhofer, “Blockchain Science: Distributed Ledger Technology”, independently Published, ISBN-10 : 1793471738, 2019.
- Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the Open Blockchain”, Shroff/O'Reilly, 2017.

Reference Books:

- Elaine Shi, “Foundations of Distributed Consensus and Blockchains”, (URL: http://elaineshi.com/docs/blockchain-book.pdf), 2020.
- Alan T. Norman, “Blockchain Technology Explained: the Ultimate Beginner s Guide About Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA and Smart Contracts”, Amazon Digital Services, 2017.
- Bahga, Arshdeep, and Vijay Madisetti. "Blockchain applications: a hands-on approach", VPT, 2017.

CO-PO & PSO Correlation

Course Name: Blockchain Fundamentals and Applications												
	Program Outcomes								PSOs			
Course Outcomes	1	2	3	4	5	6	7	8	1	2	3	4
CO1:	3	3	2	1	3				1	2		
CO2:	2	2	2	1	3				1	2		
CO3:	3	3	2	2	3				1	3		
CO4:	2	2	1	1	3				1	2		
CO5:	3	3	2	2	3				1	3		

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**II**
Name of the Course:		**Information Retrieval**	**Course Code:**		**SOE-M-CSE213(1)**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

The objectives of this course to understand the basic of information retrieval and various retrieval models, indexing, clustering, classification and image retrieval and machine learning techniques for text classification and clustering.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	To use different information retrieval techniques in various application areas
CO2	Perform indexing and pattern matching techniques for efficient query processing and retrieval of information.
CO3	Apply various classification and clustering techniques using machine learning.
CO4	To implement retrieval systems for web and Image search tasks.

Syllabus:

UNIT-I: Introduction

Basic concepts, Practical issues, Retrieval process, Architecture, Boolean retrieval, Retrieval evaluation, Open source retrieval systems, History of web search, Web characteristics. Impact of the web on information retrieval, Information retrieval versus web search, Components of a search engine.

UNIT-II: Retrieval Models

Taxonomy and characterization of information retrieval models, Boolean model, Vector model, Term weighting, Scoring and ranking; Language models; Set theoretic models. Probabilistic models, Algebraic models, Structured text retrieval models; Models for browsing

UNIT-III: Indexing

Static and dynamic inverted indices. Index construction and index compression; Searching; Sequential searching and pattern matching, Query operations, Query languages, Query processing; Relevance feedback and query expansion; Automatic local and global analysis, Measuring effectiveness and efficiency.

UNIT-IV: Classification and Clustering

Text classification and Naïve Bayes, Vector space classification, Support vector machines and Machine learning on documents, Flat clustering, Hierarchical clustering; Matrix decompositions and latent semantic indexing; Fusion and meta learning.

UNIT-V: Searching the web

Searching the web, Structure of the web, IR and web search, Static and dynamic Ranking, Web crawling and indexing, Link analysis, XML retrieval, Multimedia IR Models and languages, Indexing and searching, Parallel and distributed IR, Digital libraries.

UNIT-VI: Image Retrieval

Introduction to content-based image retrieval, Challenges in image retrieval, Image representation, Indexing and retrieving images; Relevance feedback.

Text Books:

- Introduction to Information Retrieval, Manning C., P. Raghavan & Schutze H., First South Asian Edition. Cambridge University Press.
- Modern Information Retrieval: The concepts and Technology behind Search. Yates R.B. & Neto B. R., 2nd Ed., ACM Press Books.

Reference Book:

- Information Retrieval - Implementing and Evaluating Search Engines. Büttcher S., Clarke C. & Cormack G., MIT Press.
- Information Storage and Retrieval, Korfhage R.. Wiley.
- Principles of Information Retrieval. Paliwal P. & Balakrishnan S., Anmol Publications Pvt. Ltd.

CO-PO&PSO Correlation

Course Name : Information Retrieval								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1	1	1			1		
CO2:	1	1	1			1	1	
CO3:	1	1	1			2	1	
CO4:	1	1	2			2	2	

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**II**
Name of the Course:		**Soft Computing**	**Course Code:**		**SOE-M-CSE213(2)**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

A unified and unique mathematical treatment of various soft computing techniques for constructing intelligent systems, in modelling, optimization and control. The course covers the theory and applications of neural networks, fuzzy logic, evolutionary strategies and genetic algorithms in developing intelligent systems with examples and practical applications.

Course Outcomes:

Keeping in view the philosophy experiential learning this courses should aim to: -

CO Number	Course Outcome
CO1	Recognize the feasibility of applying a soft computing methodology for a particular problem.
CO2	Recognize Develop intelligent machines to provide solutions to real world problems, which are not modelled or too difficult to model mathematically.
CO3	Exploit the tolerance for Approximation, Uncertainty, Imprecision, and Partial Truth in order to achieve close resemblance with human like decision making.

Syllabus:

UNIT-I: Neural Networks-1 (Introduction & Architecture)

Neuron, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto- associative and hetro-associative memory.

UNIT-II: Neural Networks-II (Back Propagation Networks)

Architecture: perception model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications.

UNIT-III: Fuzzy Logic-I (Introduction)

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT-IV: Fuzzy Logic –II (Fuzzy Membership, Rules)

Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

UNIT-5: Genetic Algorithm (GA)

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators: Crossover, Mutation, Generational Cycle, GA optimization problem, applications.

Text Books:

- "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" by S. Rajsekaran & G.A. Vijayalakshmi Pai, Prentice Hall of India.
- "Artificial Intelligence and Intelligent Systems" by N.P.Padhy, Oxford University Press.

Reference Books:

- Siman Haykin "Neural Netowrks", Prentice Hall of India.
- Timothy J. Ross "Fuzzy Logic with Engineering Applications", Wiley India.
- Kumar Satish "Neural Networks", Tata Mc Graw Hill.

CO-PO&PSO Correlation

Course Name: Soft Computing								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2		2	1		1		
CO2:	2	2	2		1		1	
CO3:	1	1						1

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**II**
Name of the Course:		**Wireless Sensor Network and IoT**	**Course Code:**		**SOE-M-CSE213(3)**
Credits	**:**	**3**	**No of Hours**	**:**	**3 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

This course covers fundamentals of wireless network technology and distributed sensor networks. It also covers various WSN applications in areas of environmental monitoring, smart energy systems, battle field surveillance, home automation, medical monitoring, mobile computing, etc. Course touches upon integrated network engineering, embedded system engineering and sensor technology in the context of WSN.

Course Outcomes:

Upon successful completion of this course, the student will be able:

CO Number	Course Outcome
CO1	Implement the WSN routing protocols.
CO2	Identify medium access control protocols and address physical layer issues.
CO3	Implement the transport layer protocols for sensor networks.
CO4	Identify the WSN design requirements.
CO5	Identify the WSN software level platform.

Syllabus:

UNIT–I: Overview of Wireless Sensor Networks

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.

UNIT–II: Architectures

Single Node Architecture, Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture, Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT-III: Networking Sensors

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts, S, MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols, Energy, Efficient Routing, Geographic Routing.

UNIT-IV: Infrastructure Establishment

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT-V: Sensor Network Platforms and Tools

Sensor Node Hardware, Berkeley Motes, Programming Challenges, Node level software platforms, Node level Simulators, State centric programming.

Text Books:

- Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
- Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks, An Information Processing Approach", Elsevier, 2007.

Reference Books:

- Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks,Technology, Protocols, And Applications", John Wiley, 2007.
- Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

CO-PO&PSO Correlation

Course Name: Wireless Sensor Network and IoT								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2					3		
CO2:	3	2	1		1			2
CO3:	3	2			1		1	2
CO4:	1	2			1		1	1
CO5:	1					3		

Note: 1.: Low 2.: Moderate 3.: High

Programme	:	**M. Tech.**	**Semester**	:	**II**
Name of the Course	:	**Research Methodology**	**Course Code:**		**SOE-M-CSE210**
Credits	:	**3**	**No of Hours**	:	**3 Hrs./week**
Max Marks	:	**100**			

Course Description:

The course is designed to provide in-depth knowledge of research methodology in all fields of computer science and engineering and other disciplines. This course thoroughly covers the topic of research methodology to enhance the quality of the research. Research methodology provides vital information regarding thorough literature review, critical thinking and logical reasoning, problem formulation, designing of experiments, data analysis, and interpretation, thesis writing, scientific writing, and presentation skills. This subject will provide an appropriate platform for postgraduate students and doctoral research scholars for high-quality research in a scientific manner.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Explain the basic concepts of research and its methodologies.
CO2	Identify appropriate research topics, select and define appropriate research problems and parameters
CO3	Organize and research more appropriately by using various research techniques.
CO4	Write research report and thesis.
CO5	Justify the need for intellectual property rights and patent laws.

Syllabus:

UNIT-I: Foundation of Research

Definitions and objectives of the research, types of research, research approaches, the significance of research, main components of research process; Defining a research problem: reviewing the literature, framing the research problem, hypotheses, Qualities of a Good Hypothesis, Hypothesis Testing – Logic & Importance. Research Paradigms in CSE, Grand Challenges for CSE Research.

UNIT-II: Data Source, Measurement, and Sampling

Data Source: Meaning and Importance of Data, Sources of Data, Use of Secondary Data, Methods of Collecting Primary Data, Observation Method, Experimentation, Simulation, Interviewing, Panel Method, Mail Survey, Projective Technique

Measurement: Concept of measurement, Problems in measurement in research – Validity, and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. External and Internal Validity, Levels of Measurement, Scaling, and Qualitative Measures.

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining the size of the sample– Practical considerations in sampling and sample size.

UNIT-III: Research Design

Research Design: Elements and Characteristics, Quantitative and Qualitative Research Design, Quantitative vs. Qualitative Research Design, Fixed vs. Flexible Research Design, the 5 Types of Research Designs: Descriptive, Experimental, Correlational, Diagnostic, and Explanatory Research Design. Research Design Types by Grouping: Cohort, Cross-sectional, Longitudinal and Cross-sequential study, Probabilistic Equivalence, Hybrid Experimental Designs and Quasi-Experimental Design, Research design case studies for CSE.

UNIT-IV: Data Interpretation and Analysis

Data Preparation, data processing, data analysis: Correlation and Regression, Discriminant & Logit Analysis, Factor Analysis, Cluster Analysis, Multidimensional Scaling, and Conjoint Analysis, Structural Equation Modeling and Path Analysis, hypothesis testing, Strategies and tools, data analysis with statistical packages, Descriptive Statistics and Correlation; and Inferential Statistics, Generalization and Interpretation.

UNIT-V: Research Report and Ethics

Report Writing: Structure and components of scientific reports, types of reports, technical reports, and thesis. Thesis writing – different steps and software tools (Word processing, etc) in the design and preparation of the thesis, layout, structure (chapter plan) and language of typical reports, Illustrations and tables, bibliography, referencing, and footnotes. Oral presentation, planning, software tools, creating and making an effective presentation, use of visual aids, the importance of effective communication.

Research Ethics: ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copyright, royalty, trade-related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgment, plagiarism, reproducibility, and accountability.

Text Books:

- Graeme Johanson, Kirsty Williamson, "Research Methods: Information, Systems, and Contexts", Elsevier Science, 2017
- Monique Hennink, Inge Hutter, Ajay Bailey "Qualitative Research Methods", SAGE Publications, 2020

References Books:

- David Manz "Research Methods for Cyber Security by Thomas Edgar", Elsevier Science, 2017.
- Ryhan Ebad "Research Methodology in Computer Science", Centrum Press, 2013.
- Jonathan Lazar, Jinjuan Heidi Feng, Harry Hochheiser "Research Methods in Human-Computer Interaction", Elsevier Science, 2017.

CO-PO & PSO Correlation

Course Name: Research Methodology								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1	3	3	4	5	1	2	3
CO2:	2	3	1			1	2	1
CO3:	2	2	3	1	1		1	1
CO4:	2	3	1				2	
CO5:	2	3				1	1	1

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M. Tech**	**Semester**	**:**	**II**
Name of the Course:		**Signal Processing and Data Analytics Lab**	**Course Code:**		**SOE-M-CSE212(1)**
Credits	**:**	**2**	**No of Hours**	**:**	**4 Hrs. / Week**
Max Marks	**:**	**50**			

Course Descriptions:

The laboratory augments the lecture course in Signal Processing and Data Analytics by programming signal processing and classification techniques. The laboratory introduces programming concepts of signal analysis and signal classification.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	2D signal analysis using Fourier transform
CO2	2D signal analysis using Fourier transform
CO3	Analysis of signals using machine learning techniques
CO4	Signal classification using machine learning techniques
CO5	2D signal classification using CNN

The following concepts will be covered in the lab:

- Forward and Inverse Fourier transform of 1-Dimensional Signal.
- Forward and Inverse Fourier transform of 2-Dimensional Signal.
- Analysis 1D and 2D signal spectrum using machine learning techniques.
- Classification of different signals using SVM classifer.
- Classification of 2D signal using CNN.

Text Books:

- David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016
- S. K. Mitra, “Digital Signal Processing: A Computer-Based Approach”, 3rd edition, McGraw-Hill, 2006
- Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.
- Li Tan , Jean Jiang, “Digital Signal Processing fundamentals and Applications”, 2nd edition, Academic Press,2013

CO-PO & PSO Correlation

Course Name: Signal Processing and Data Analytics Lab								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**2**	**2**				**3**		
CO2:	**2**			**1**				**2**
CO3:	**2**	**2**					**1**	**2**
CO4:	**2**	**1**					**2**	**1**
CO5:	**1**	**2**		**1**		**2**		

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M.Tech.**	**Semester :**	**II**
Name of the Course:		**Digital Image Processing Lab**	**Course Code:**	**SOE-M-CSE212(2)**
Credits	**:**	**2**	**No of Hours :**	**4 Hrs. / Week**
Max Marks	**:**	**50**		

Course Descriptions:
This course is an introduction to image processing, image analysis techniques and concepts. Areas include: Imaging sensors and their principles; Image representation and storage, coding and compression techniques, lossy versus lossless; techniques for noise reduction.

Course Outcomes:
At the end of the course, students should be able to:

CO Number	Course Outcome
CO1	Learn concepts, process and practice DIP methodologies
CO2	Learn image processing in spatial and frequency domain
CO3	Learn image restoration and segmentation
CO4	Learn image compression using various techniques

Following concepts will be covered in the lab

- Implement Low Pass Filters – Gaussian, Butterworth, Ideal.
- Implement High Pass Filters – Gaussian, Butterworth, Ideal.
- Perform Image Enhancement in Spatial Domain through Gray Level
- Image filtering in Frequency Domain
- Wavelet transforms
- Transformation Function. Histogram Equalization
- Histogram Specification.
- Image compression
- Image restoration
- Implementation of Morphological Operations, image processing, image segmentation and for Edge detection.

Software Requirements:

- Scientific computing tool.

Text Books:

- John H Davies, "MSP430 Microcontrollers Basics", 1st edition, Newnes Publishers, 2008
- C P Ravikumar, "MSP430 Microcontrollers in Embedded Sys-tem Projects", 1st edition, Elite Publishing House, 2012.

CO-PO & PSO Correlation

Course Name: Digital Image Processing Lab								
	POs					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**2**	**2**	**1**			**1**	**2**	
CO2:	**1**	**2**	**2**			**1**	**2**	**2**
CO3:	**1**	**2**	**1**			**1**	**2**	
CO4:		2	1			1		

Programme	**:**	**M.Tech.**	**Semester : II**	
Name of the Course:		**Blockchain Fundamentals and Applications Lab**	**Course Code:**	**SOE-M-CSE212(3)**
Credits	**:**	**2**	**No of Hours :**	**4 Hrs / Week**
Max Marks	**:**	**50**		

Course Descriptions:
Explore the core principles of blockchain technology and its diverse applications. Understand distributed ledger, consensus algorithms, cryptography, and smart contracts. Examine real-world use cases in finance, supply chain, healthcare, and more. Gain hands-on experience in developing and deploying smart contracts. Address regulatory considerations and challenges. Suitable for professionals interested in leveraging blockchain's transformative potential.

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

CO Number	Course Outcome
CO1	Understand and explain blockchain fundamentals, including distributed ledger, consensus mechanisms, and smart contracts.
CO2	Identify and assess appropriate use cases for implementing blockchain solutions in various industries.
CO3	Develop and interact with smart contracts on popular blockchain platforms.
CO4	Evaluate challenges and propose solutions for implementing blockchain projects.

The following concepts will be covered in the lab:

- Setting up a Blockchain Development Environment
- Creating and Managing Blockchain Wallets
- Implementing a Basic Blockchain Network
- Developing and Deploying Smart Contracts
- Interacting with Smart Contracts using Web3.js or similar libraries
- Mining and Proof-of-Work (PoW) Consensus Simulation
- Implementing Proof-of-Stake (PoS) Consensus Algorithm
- Building Decentralized Applications (DApps) on Ethereum

- Exploring Hyperledger Fabric for Enterprise Blockchain Solutions
- Testing and Debugging Blockchain Applications

Text Books:

- Arvind Narayanan, Joseph Bonneau, Edward Felten, andrew Miller, Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive introduction", Princeton University Press, 2016.
- Roger Wattenhofer, "Blockchain Science: Distributed Ledger Technology", independently Published, ISBN-10 : 1793471738, 2019.
- Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", Shroff/O'Reilly, 2017.
- Elaine Shi, "Foundations of Distributed Consensus and Blockchains", (URL: http://elaineshi.com/docs/blockchain-book.pdf), 2020.

CO-PO & PSO Correlation

Course Name: Blockchain Fundamentals and Applications Lab												
	Program Outcomes								PSOs			
Course Outcomes	1	2	3	4	5	6	7	8	1	2	3	4
CO1:	3	3	2	1					1	2		
CO2:	2	2	2	1					1	2		
CO3:	3	3	2	2					1	3		
CO4:	2	2	1	1					1	2		

Note: 1.: Low 2.: Moderate 3.: High

Programme	:	**M. Tech.**	**Semester**	:	**II**
Name of the Course	:	**Next Generation Database Lab**	**Course Code:**		**SOE-M-CSE207**
Credits	:	**2**	**No of Hours**	:	**4 Hrs./week**
Max Marks	:	**50**			

Course Description:

In this course students will learn to implement the concepts of NoSQL database.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand the implementation procedures to create NoSQL Database.
CO2	Understand the implementation queries for NoSQL Database.
CO3	Understand different Cloud platform and their installation

The following concepts will be covered in the lab:

- Implementation of DDL commands - overview of using sql tool, data types in sql, creating tables (along with primary and foreign keys), altering tables and dropping tables.
- Implementation of DML commands- insert, select, update, delete etc.
- Implementation of queries using any, all, in, exists, not exists, union, intersect, constraints etc.
- Implementation of sub queries (nested, correlated) and joins (inner, outer and equi).
- Implementation of queries using count, sum, avg, max, min, group by, having, views creation and dropping.
- Implementation of triggers - creation of trigger, insertion using trigger, deletion using trigger, updating using trigger.
- Implementation of procedures- creation of stored procedures, execution of procedure, and modification of procedure.
- Implementation of cursors- declaring cursor, opening cursor, fetching the data, closing the cursor.

Text Books:

- Rajiv Chopra, S. Chand, “Database Management System (DBMS): A Practical Approach” .
- Sharad Maheshwari, Ruchin Jain, “DBMS – Complete Practical Approach”, Firewall Media.

CO-PO & PSO Correlation

Course Name: Next Generation Database Lab								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**	**2**				**1**	**1**	**1**
CO2:	**3**	**2**					**1**	**1**
CO3:	**2**	**2**					**2**	

Note: 1: Low 2.: Moderate 3: High

Programme	:	**M. Tech.**	**Semester**	:	**II**
Name of the Course	:	**Business Intelligent & Machine learning Lab**	**Course Code:**		**SOE-M-CSE208**
Credits	:	**2**	**No of Hours**	:	**4 Hrs./week**
Max Marks	:	**50**			

Course Description:

This course is about the implementation of basic machine learning algorithms. Students will learn to create machine learning models.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand the implementation procedures for the machine learning algorithms
CO2	Construct machine learning models based on the attributes of applications and datasets
CO3	Understand different metrics for evaluation of machine learning models
CO4	Identify and apply Machine Learning algorithms to solve real world problems

The following concepts will be covered in the lab:

- Implementation of DFS for water jug problem
- Implementation of BFS for tic-tac-toe problem using
- Implementation of TSP using heuristic approach
- Implementation of Simulated Annealing Algorithm
- Implementation of Hill-climbing to solve 8- Puzzle Problem
- Implementation of Data classification using Naïve Bayes classifier
- Implementation of Data classification using K-Nearest Neighbor classifier
- Implementation of K-Means Clustering Algorithm
- Implementation of Hierarchical Clustering Algorithm
- Implementation of Linear Regression

Text Books:

- David Poole, Alan Mackworth, Randy Goebel, “Computational Intelligence: a logical approach”, Oxford University Press.
- Saikat Dull, S. Chjandramouli, Das, “Machine Learning”, Pearson
- R. O. Duda, P. E. Hart and D.G. Stork, “Pattern Classification”, John Wiley, 2001.
- G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem-solving”, Fourth Edition, Pearson Education.

CO-PO&PSO Correlation

Course Name: Business Intelligent & Machine learning Lab								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**	**2**	**1**			**1**	**1**	**1**
CO2:	**2**	**3**					**1**	**1**
CO3:	**2**	**3**	**1**				**2**	
CO4:	**1**	**1**	**1**			**1**	**1**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme	**:**	**M. Tech**	**Semester**	**:**	**II**
Name of the Course:		**Information Retrieval Lab**	**Course Code:**		**SOE-M-CSE214(1)**
Credits	**:**	**2**	**No of Hours**	**:**	**4 Hrs. / Week**
Max Marks	**:**	**50**			

Course Descriptions:

Information retrieval is the process through which a computer system can respond to a user's query for text-based information on a specific topic. IR was one of the first and remains one of the most important problems in the domain of natural language processing (NLP). Web search is the application of information retrieval techniques to the largest corpus of text anywhere -- the web -- and it is the area in which most people interact with IR systems most frequently.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Outline basic concepts of the information retrieval.
CO2	Apply appropriate Query technique on given real world applications
CO3	Develop user interfaces and visualization for search process to address research issues.
CO4	Identify appropriate indexing and searching method for Feature Extraction.
CO5	Explain the multimedia IR models, Indexing and searching the web concepts

The following concepts will be covered in the lab:

- To Find the Weights of specific Term in a given Documents Using Python
- Implement hands-on experience store, and retrieve information from www using semantic approaches
- Implement the usage of different data/file structures in building computational search engines
- Implement the Analysis and the performance of information retrieval using various classification algorithm on text
- Implement the Analysis and the performance of information retrieval using Clustering algorithm on text
- Implement how to analyse ranked retrieval of a very large number ofdocuments with hyperlinks between them
- Implement how N-grams are used for detection and correction of spelling errors.

- Implement Domain specific Search Engine
- Case Study on: Demonstrate Information visualization technologies like Cognition and perception in the Internet or Web search engine

Text Books:

- Introduction to Information Retrieval, Manning C., P. Raghavan & Schutze H., First South Asian Edition. Cambridge University Press.
- Modern Information Retrieval: The concepts and Technology behind Search. Yates R.B. & Neto B. R., 2nd Ed., ACM Press Books.
- Information Retrieval - Implementing and Evaluating Search Engines. Büttcher S., Clarke C. & Cormack G., MIT Press.
- Information Storage and Retrieval, Korfhage R.. Wiley.
- Principles of Information Retrieval. Paliwal P. & Balakrishnan S., Anmol Publications Pvt. Ltd.

CO-PO & PSO Correlation

Course Name: Machine Learning Lab								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3	2	2	1	1			3
CO2:	2	3	2	1	2			3
CO3:	2	2	2	2	1			3
CO4:	2	2	3	1	2			3
CO5:	2	2	2	2	1			3

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech**	**Semester**	**:**	**II**
Name of the Course:		**Soft Computing Lab**	**Course Code:**		**SOE-M-CSE214(2)**
Credits	**:**	**2**	**No of Hours**	**:**	**4 Hrs. / Week**
Max Marks	**:**	**50**			

Course Descriptions:

This course will cover fundamental concepts used in Soft computing. The concepts of Fuzzy logic (FL) will be covered first, followed by Artificial Neural Networks (ANNs) and optimization techniques using Genetic Algorithm (GA). Applications of Soft Computing techniques to solve a number of real life problems will be covered to have hands on practices. In summary, this course will provide exposure to theory as well as practical systems and software used in soft computing.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Explore methods that implements neural network techniques.
CO2	Practice the fuzzy set relations using different operations.
CO3	Design Regression techniques for a set of data points.
CO4	Capture an appropriate classification model for analytical tasks.

The following concepts will be covered in the lab:

- Introduction to Soft Computing
  - Concept of computing systems.
  - "Soft" computing versus "Hard" computing
  - Characteristics of Soft computing
  - Some applications of Soft computing techniques
  - Solving single-objective optimization problems using Gas
- Program to implement logic gates.
- Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
- Implement svm classification by fuzzy concepts.
- Implementation of Genetic Application
- Implementation of Perceptron Learning Algorithm
- Implementation of Unsupervised Learning Algorithm
- Write a program to implement artificial neural network without back propagation.
- Implement travelling sales person problem (tsp) using genetic algorithms.
- Implement crisp partitions for real-life iris dataset
- Implement linear regression and multi-regression for a set of data points

- Perceptron net for an AND function with bipolar inputs and targets.
- Program for Pattern storage of 10 digits with Discrete Hopfield Network

Text Books:

- G. A. Vijayalakshami, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran", PHI.
- E. Goldberg, "Genetic Algorithms: Search and Optimization".
- Chin Teng Lin, "Neuro-Fuzzy Systems", C. S. George Lee, PHI.
- Joe choong, "Build_Neural_Network_With_MS_Excel_sample".

CO-PO & PSO Correlation

Course Name: Soft Computing Lab								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**	**1**	**2**	**2**		**1**	**2**	**2**
CO2:	**3**	**3**	**2**	**2**		**2**	**2**	**2**
CO3:			**3**			**1**		**3**
CO4:	**1**						**1**	**2**

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M.Tech.**	**Semester :**	**II**
Name of the Course:		**Wireless Sensor Networks and IoT Lab**	**Course Code:**	**SOE-M-CSE214(3)**
Credits	**:**	**2**	**No of Hours :**	**4 Hrs / Week**
Max Marks	**:**	**50**		

Course Descriptions

In this course, introduction of evolution of Wireless sensor networks with internet technology and need for IoT. Discusson on IoT reference layer and various protocols and software. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms. Make the students to apply IoT data for business solution in various domain in secured manner. To understand the functionalities of various layers of OSI model. To demonstrate the working of network components such as switch, router, gateways, etc. To inculcate the use of tools in network topology design. To understand the distributed sensing capabilities and the ease of deployment provided by a wireless communication paradigm. To efficiently design WSN communication system for a given set of parameters and constraints.

Course Outcomes

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

CO Number	Course Outcome
CO1	Design the network for different applications, configure and manage the network components
CO2	Analyze the different types of sensors to be used based on the problem definition.
CO3	Design and develop the WSN communication system for the given parameters and constraints in real
CO4	Select protocols for a specific IoT application Utilize the cloud platform and APIs for IoT application
CO5	Choose the sensors and actuators for an IoT application Experiment with embedded boards for creating IoT prototypes

The following concepts will be covered in the lab:

Experiments will be completed by students based on various wireless sensors and actuators with the real life application like door automation, light automation using boards like aurdino UNO and RaspberryPi. Under this lab they will learn to connect boards, supply data, connection with cloud etc.

Text Books :

- Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016
- Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.
- "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).
- "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press).
- C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Second Edition, Pearson Publication, 2015.
- Holger Karl and Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", First Edition, John wiley publication, 2011

CO-PO & PSO Correlation

Course Name: Wireless Sensor Networks and IoT Lab												
	Program Outcomes								PSOs			
Course Outcomes	1	2	3	4	5	6	7	8	1	2	3	4
CO1:	2		3		1		3	2	2			3
CO2:		1	2	3	1	3	2			3		
CO3:	3		1	2						2	1	
CO4:					3		2	1	1			

Note: 1.: Low 2.: Moderate 3.: High

Scheme & Syllabus of M. Tech (CSE) Programme

S. No	Subject Code	Subject	Periods Per Week			Scheme of Examination and Marks				Credit L+[T+P]/2
						PRE**		ESE *	Total Marks	
			L	T	P	Mid Sem	TA			
1.	SOE-M-CSE-21-301	Elective IV	3	1	0	30	20	50	100	4
2.	SOE-M-CSE-21-302	Internship/ Project/ Research	0	0	16	0	100	100	200	8
3.	SOE-M-CSE-21-303	Seminar	0	0	6	0	50	50	100	3
4.	SOE-M-CSE-21-304	Elective V	3	1	0	30	20	50	100	4
Total			6	2	22	60	190	250	500	19

Semester III

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Elective-IV

S. No	Subject Code	Subject Name
1.	SOE-M-CSE-21-301(1)	Web Analytics in Digital Marketing
2.	SOE-M-CSE-21-301(2)	Data Analysis & Decision Making in Business Analytics
3.	SOE-M-CSE-21-301(3)	Healthcare Data Analytics
4	SOE-M-CSE-21-301(4)	Operations Research

Elective-V

S. No	Subject Code	Subject Name
1.	SOE-M-CSE-21-304(1)	Deep Learning and Applications
2.	SOE-M-CSE-21-304(2)	Natural Language Processing
3.	SOE-M-CSE-21-304(3)	Digital Forensics and Malware

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Web Analytics in Digital Marketing**	**Course Code:**		**SOE-M-CSE-21-301(1)**
Credits	**:**	**4**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

The Objective of the Digital Marketing and Web Analytics Course is to provide students with the knowledge about business advantages of the digital marketing and its importance for marketing success and assess that how website visitors view and interact with a site's pages and features, and business intelligence, which would allow using data on customer purchasing patterns, demographics, and demanding trends to make effective strategic decisions.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	To provide students with the fundamentals and essentials of Digital marketing and web analytics.
CO2	To make understand to design and Implementing website.
CO3	To enable students to use of optimization techniques.
CO4	To enable students to use of Google analytics.

Syllabus:

UNIT-I: Introduction of the Digital Marketing

Digital vs. Real Marketing, Digital Marketing Channels, Creating initial digital marketing plan, Content management, SWOT analysis, Target group analysis.

UNIT-II: Web Design

Optimization of Web sites, MS Expression Web, creating web sites, MS Expression, SEO Optimization, Writing the SEO content, Writing the SEO content, Google AdWords- creating accounts, Google AdWords- types.

UNIT-III: Web Analytic fundamentals:

Capturing data: Web logs or JavaScripts tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, selecting optimal web analytic tool, understanding clickstream data quality, identifying unique page definition, Using cookies, Link coding issues.

UNIT-IV: Web analytics 2.0

Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis: CI data sources, Toolbar data, Panel data, ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.

UNIT-V: Google Analytics

Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

Text Books:

1. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons (2002).
2. Digital Marketer. Pullizi, J. (2014) Epic Content Marketing, Mcgraw Hill Education.

Reference Books:

3. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc. (2010), 2nd ed.
4. Kaushik A., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons (2002),1st ed.

CO-PO & PSO Correlation

Course Name: Web Analytics in Digital Marketing								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3		1		1	2	2	3
CO2:	1	2	3			3	2	2
CO3:	2	2	2			2	2	3
CO4:	3	2	1			1	2	2

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Data Analysis & Decision Making in Business Analytics**	**Course Code:**		**SOE-M-CSE-21-301(2)**
Credits	**:**	**4**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

This course provides step by step evolution from Barter System to present Digital & online Business System, which moves everything of day to day work in every Core. Importance of Web, Social & Mobile analytics is well accepted today in Business. Here students learn Different operational & Functional Architecture of Business Intelligence, Data Warehousing Technologies. Data Mining & finally Smarter Decisions using different Analytical Tools.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Describe the basic concepts of business analytics and optimization.
CO2	Describe the basic concepts of business intelligence, components and architecture.
CO3	Explain the basic concepts of data mining
CO4	Explain the basic concepts of web, social media and mobile analytics with its future trends

Syllabus:

UNIT-I: Introduction to Business Analytics

What is BA? Objective of BA, BA user, BA options. Introduction to Business Analytics, the value of Business Analytics to Business organization, the impact of Business Analytics on diverse industries, Advantages to implementing BA solutions, Key Business Analytics concepts, BA support for decision-making, High-level architecture of Business Analytics, the need for Business Analytics, the importance of reference architecture, Meaning of the Business reference architecture.

UNIT-II: Descriptive Analytics

Business Intelligence (BI), Scope of BI solutions and their fitting into existing infrastructure, BI Components and architecture, BI Components, Future of Business Intelligence, SaaS and Cloud computing techniques, Functional areas of BI tools, End user assumptions, Setting up data for BI.

UNIT-III: Data warehouse

OLAP and advanced analytics, Supporting the requirements of senior executives including performance management, Glossary of terms and their definitions specific to the field of BI and BI systems.

UNIT-III: Introduction to Big Data

Challenges, 5 V's, Ecosystem; Google's Solution Vs Hadoop, Hadoop: Ecosystem, Architecture, Cluster.

UNIT-IV: Predictive Analytics

Introduction, what is Data Mining? Concepts of Data mining, Technologies Used, Data Mining Process, KDD Process Model, CRISP – DM, Mining on different kinds of data, Applications of Data Mining, Challenges of Data Mining

UNIT – V: Social, Web and Mobile Analytics

Overview of web & social media. Need of using analytics, Web analytics technical requirements. Social media environment, Impact of social media on business, current analytics platforms, Web Analytics Vs Mobile Analytics, Social media Analytics Vs Mobile analytics, Need of mobile analytics, Basics of mobile computing, WAP gateway or GGSN support, APNs or regional POPs support, Architecture components, mobile web-services, overview of mobile cloud.

Text Books:

1. Wayne Winston, S. Albrigh, Business Analytics: Data Analysis & Decision Making, 5E, 2014.

Reference Books:

1. Swain Scheps, "Business Intelligence for Dummies", 2016.
2. Randy Bartlett, A practitioner's Guide to Business Analytics, 2013.

CO-PO & PSO Correlation

Course Name: Data Analysis & Decision Making in Business Analytics								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3	3	2			3	3	3
CO2:	2		2			3	3	2
CO3:	2	2	2			2	2	3
CO4:	2	2	1			1	2	1

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Healthcare Data Analytics**	**Course Code:**		**SOE-M-CSE-21-301(3)**
Credits	**:**	**4**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

This course will enable the students to build a basic working knowledge of data analysis on clinical intelligence platforms using appropriate techniques and methodologies.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Describe the tools and techniques used for data analytics in health care organizations
CO2	Understand the electronic health records and clinical decision support systems
CO3	Identify techniques to gain insights from biomedical image analysis
CO4	Understand the genomic data and its applications in personalized medicine
CO5	Understand the use of Natural Language Processing in clinical text

Syllabus:

UNIT-I: Introduction to Healthcare Data Analytics

Introduction, Healthcare Data Sources and Basic Analytics: Electronic Health Records, Biomedical Image Analysis, Sensor Data Analysis, Biomedical Signal Analysis, Genomic Data Analysis, Clinical Text Mining, Mining Biomedical Literature, Advanced Data Analytics for Healthcare, Applications and Practical Systems for Healthcare

UNIT-II: Electronics Health Records and Clinical Decision Support Systems

Introduction to EHR, Components of EHR, Benefits of EHR, Challenges of using HER, Types of Biomedical Signals: ENG, EMG, ECG, EEG, EGG, PCG, Introduction to CDSS, Types of CDSS: Knowledge-based CDSS, Non-Knowledge-based CDSS, Diagnostic Decision Support, Challenges of CDSS: Technical Design Issues, Legal and Ethical Issues

UNIT-III: Biomedical Image Analysis

Introduction, Biomedical Imaging Modalities, Object Detection, Image Segmentation, Image Registration, Feature Extraction: Object features, feature selection and Dimensionality Reduction, Principal Component Analysis

UNIT-IV: Genomic Data Analysis for Personalized Medicine

Introduction to genomics data, Genomic data generation, Methods and standards for Genomic data analysis, Types of Computational Genomics Studies towards Personalized Medicine: Discovery of Biomarker and Molecular Signatures, Genome-Wide Association Study, Discovery of Disease Relevant Gene Networks

UNIT-V: Natural Language Processing and Data Mining for Clinical Text

Introduction to Natural Language Processing, Core NLP components: Morphological Analysis, Lexical Analysis, Syntactic Analysis, Semantic Analysis, Data Encoding, Mining Information from Clinical Text, Challenges of Processing Clinical Reports, Clinical Applications

Text Books:

1. Chandan K. Reddy and Charu C. Aggarwal "Healthcare Data Analytics", Chapman & Hall/CRC.

Reference Books:

2. Vikas Kumar, "Healthcare Analytics made simple", Packet Publishing Limited.
3. Hui Yang and Eva K. Lee "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement", Wiley publication.

CO-PO & PSO Correlation

Course Name: Healthcare Data Analytics								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3		2			3		3
CO2:	1						3	2
CO3:	2	2	2			2	2	
CO4:		2	1			1	2	3
CO5:		3				1		1

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Operations Research**	**Course Code:**		**SOE-M-CSE-21-301(4)**
Credits	**:**	**4**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

Operations Research now a day widely used in the area of decision making for the real life problems. Managers and decision makers get idea for optimizing and approximating industrial problems. They not only strive to devise appropriate measures for problem solving but also apply scientific techniques to monitor the organizations ongoing activities such as production mix, transportation, queuing, assignment, goal and game problem.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Formulate mathematical problems and select optimal problems solving techniques for a given problem using LP.
CO2	Formulate and solve transportation problem.
CO3	Formulate and solve Assignment problem.
CO4	Demonstrate and solve problems related to Decision Theory and Decision Tree.
CO5	Demonstrate and solve real life problem relating to Queuing Theory and Game Theory.

Syllabus:

UNIT-I: Linear Programming

Basic concept; Structure of Linear Programming Model; Application areas of Linear Programming; General Mathematical Model of Linear Programming Problem; Guidelines on Linear Programming Model Formulation; Examples of LP Model Formulation in various functional areas of management; Graphical Solution Method of LP Problems; The Simplex Method (Maximization Case; Minimization Case-Two Phase Method & Big M Method).

UNIT-II: Relational Data Models

Transportation Problem: Mathematical Model of Transportation Problem; The Transportation Algorithm; Methods for Finding Initial Solution (North-West Corner Method, Least Cost Method, Vogel's Approximation); Test of Optimality- MODI Method (Transportation Algorithm).

UNIT-III: Assignment Problem:

Mathematical Model of Assignment Problem; Solution Methods of Assignment Problem, Hungerian Method for solving Assignment Problem; Variations in the Assignment Problem,

Multiple Optimal solutions, Maximization Case in Assignment Problem, Unbalanced Assignment Problem, Restrictions on Assignments.

UNIT-IV: Decision Theory and Decision Tree:

Steps of Decision making Process; Types of Decision Making Environment; Decision Making under Uncertainity (Optimism Criterion, Pessimism Criterion, Equal Probabilities criterion, Coefficient of Optimism Criterion, Regrate Criterion); Decision Tree Analysis, Decision Making with Utilities.

UNIT-V: Queuing Theory:

Basis of Queuing theory, elements of queuing theory, Kendall's Notation, Operating characteristics of a queuing system, Classification of Queuing models, Preliminary examples of M/M/1:∞/FCFA. Game Theory: Introduction, Characteristics of Game Theory, Two Person, Zero sum games, Pure strategy. Dominance theory, Mixed strategies (2x2, mx2), Algebraic and graphical methods.

Text Books:

1. Hamdy Taha "Operations Research: An Introduction", Pearson
2. R. Paneerselvam, "Operations Research", Prentice Hall of India Pvt. Ltd.

Reference Books:

1. P Mariappan "Operations Research", Pearson
2. H N wagner "Operations Research", Prentice Hall.
3. Ronald Rardin "Optimization in Operations Research", Pearson Education Inc.
4. R. Paneerselvam, "Operations Research", Prentice Hall of India Pvt. Ltd.

CO-PO & PSO Correlation

Course Name: Operations Research								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3	3	2		2	3	3	3
CO2:	2		3		3	3	3	2
CO3:	2		2		2	2	2	2
CO4:		2	1		1	1	2	3
CO5:		3	2			1	3	1

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Internship/ Project/ Research**	**Course Code:**		**SOE-M-CSE-21-302**
Credits	**:**	**8**	**No of Hours**	**:**	**16 Hrs./week**
Max Marks	**:**	**200**			

Course Description:

The project work can be an investigative analysis of a technical problem in the relevant area, planning and/or design project, experimental project or computer application based project on any of the topics. Each project will submit project synopsis by the end of the semester. Project evaluation committee consisting of three or four faculty members specialized in the various fields shall study the feasibility of each project work before giving consent.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain in-depth knowledge and use adequate methods in the major subject/field of study.
CO2	Create, analyze and critically evaluate different technical/research solutions
CO3	Clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings
CO4	Identify the issues that must be addressed within the framework of the specific dissertation in order to take into consideration
CO5	Apply principles of ethics and standards, skill of presentation and communication techniques.

Contents

Project work is of duration of one semesters and is expected to be completed in this semester. Each student is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The student is expected to fix their topics, complete preliminary studies like literature survey, field measurements etc. in the third semester.

Student shall study the topic of project work and define problem statement. The student shall evolve design and/or do experimental study and/or fabricate engineered device to obtain solution to the identified problem. The student shall

prepare a report and shall present a seminar on the basis of work done at the end of semester.

CO-PO & PSO Correlation

Course Name: Internship/ Project/ Research I								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**		**2**	**3**	**1**	**3**		**3**
CO2:	**1**		**2**	**3**	**3**		**3**	**2**
CO3:	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**
CO4:				**2**	**2**	**1**	**2**	**3**
CO5:				**3**	**2**	**1**	**3**	**1**

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Seminar**	**Course Code:**		**SOE-M-CSE-21-303**
Credits	**:**	**3**	**No of Hours**	**:**	**6 Hrs./week**
Max Marks	**:**	**100**			

Course Description:
Research Seminar have its own importance in a career of a student who is pursuing a professional degree. It is considered as a part of PG curriculum.

Course Outcomes:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	gain in-depth knowledge and use adequate methods in the major subject/field of study.
CO2	create, analyze and critically evaluate different technical/research solutions
CO3	clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings
CO4	identify the issues that must be addressed within the framework of the specific dissertation in order to take into consideration
CO5	able to apply principles of ethics and standards, skill of presentation and communication techniques.

Contents

Project work is of duration of one semesters and is expected to be completed in the seventh/eighth semester. Each student group consisting of not more than four members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project batches are expected to fix their topics, complete preliminary studies like literature survey, field measurements etc. in the seventh semester.

Student shall study the topic of project work and define problem statement. The student shall evolve design and/or do experimental study and/or fabricate engineered device to obtain solution to the identified problem. The student shall prepare a report and shall present a seminar on the basis of work done at the end of semester.

CO-PO & PSO Correlation

Course Name: Seminar								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1					3		
CO2:		2	1		1			2
CO3:		2			1		1	2
CO4:	1	2			1		1	1
CO5:	1					3		

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Deep Learning and Applications**	**Course Code:**		**SOE-M-CSE-21-304(1)**
Credits	**:**	**4**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. For example, asked to recognize faces, a deep neural network may learn to represent image pixels first with edges, followed by larger shapes, then parts of the face like eyes and ears, and, finally, individual face identities. Deep learning is behind many recent advances in AI, including Siri's speech recognition, Facebook's tag suggestions and self-driving cars.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain the knowledge about neural networks.
CO2	Introduce the basic concepts and techniques of deep learning.
CO3	Apply optimization techniques in in real life applications.
CO4	Develop the skills in deep learning for solving practical problems. To be familiar with a set of well-known deep neural network, convolutional neural network, filters optimization techniques.
CO5	Apply RNN and LSTM for sentiment analysis

Syllabus:

UNIT-I: Basics of Neural Networks

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

UNIT-II: Feedforward Networks and Deep Neural Networks

Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders, difficulty of training deep neural networks, Greedy layer wise training.

UNIT-III: Optimization in Deep Neural Network

Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT-IV: Recurrent Neural Network

Back propagation through time, Long Short-Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

UNIT-V: Convolutional Neural Networks:

Convolution in n-dimensions, Convolutional layers, Pooling strategies, Visualization of filters.

Text Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.

Reference Books:

2. Raúl Rojas, "Neural Networks: A Systematic Introduction", 1996.
3. Christopher Bishop , "Pattern Recognition and Machine Learning", 2007.

CO-PO & PSO Correlation

Course Name: Deep Learning and Applications								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3	2	2			3	3	3
CO2:	3	2	2			3	3	2
CO3:	2	2	2			2	2	3
CO4:		2	1			1	2	3
CO5:		3	2			1	3	1

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Natural Language Processing**	**Course Code:**		**SOE-M-CSE-21-304(2)**
Credits	**:**	**4**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

The course will provide foundational knowledge of natural language processing. In the course, basic concepts of language designing, grammars, syntax and semantics and designing of NLP systems will be covered.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Tag a given text with basic Language features
CO2	Design an innovative application using NLP components
CO3	Implement a rule-based system to tackle morphology/syntax of a language
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.

Syllabus:

UNIT-I: Introduction

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

UNIT-II: Word Level Analysis

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

UNIT-III: Syntactic Analysis

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic

Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT-IV: Semantics and Pragmatics

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

UNIT-V: Discourse Analysis and Lexical Resources

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech”, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python‖”, First Edition, O_Reilly Media, 2009.

Reference Books:

1. Breck Baldwin, “Language Processing with Java and LingPipe Cookbook”, Atlantic Publisher, 2015.
2. Richard M Reese, “Natural Language Processing with Java‖”, O_Reilly Media, 2015
3. Nitin Indurkhya and Fred J. Damerau, “Handbook of Natural Language Processing”, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval‖”, Oxford University Press, 2008.

CO-PO & PSO Correlation

Course Name: Natural Language Processing								
	Program Outcomes					PSOs		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**	**2**	**2**			**3**	**3**	**3**
CO2:	**2**	**3**	**2**			**3**	**3**	**2**
CO3:	**2**	**2**	**2**			**2**	**2**	**3**
CO4:		**2**	**1**			**1**	**3**	**3**
CO5:	**2**		**2**			**1**	**3**	**1**

Note: 1.: Low 2.: Moderate 3.: High

Programme	**:**	**M. Tech.**	**Semester**	**:**	**III**
Name of the Course:		**Digital Forensics and Malware**	**Course Code:**		**SOE-M-CSE-21-304(3)**
Credits	**:**	**4**	**No of Hours**	**:**	**4 Hrs./week**
Max Marks	**:**	**100**			

Course Description:

This course is designed to introduce the principles and practices generally required to investigate the cyber-crimes. It includes the study of various data acquisition process and tools, evidence analysis procedures and methodologies, taxonomy of digital forensics tools, analysis of network, file signature, data recovery, file system analysis, volatile memory forensics, mobile devices and cloud forensics which are the state-of-the-art requirement in the present and upcoming digital world followed by digital forensics examiner.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand the scope of digital forensic investigation and severity of crime scene.
CO2	Acquire forensic image of suspected digital device under investigation.
CO3	Examine the evidence using open source and freeware tools.
CO4	Apply different computer forensic tools for conducting forensic analysis.
CO5	Perform investigation practices using different operating systems

Syllabus:

UNIT-I: Basics of Digital Forensics

Fundamentals of Computer forensics investigation, computer forensics versus other related disciplines, A brief History of computer Forensics, benefits of computer forensics, Modern day digital forensics, Introduction to IT Act 2000, Volatile and Non-Volatile Memory, challenges in digital forensics, Strategies for forensics investigations, importance of event reconstruction.

UNIT-II: Memory Analysis

Memory organization concept, Data storage concepts, Disk partition, Data Acquisition and Authentication Process, Non-volatile memory analysis: overview of various File systems (FAT/NTFS/EXT/UFS etc.), data recovery concepts, file search and recovery, file carving approach, Volatile memory analysis: dumping RAM image, RAM analysis, Volatility framework.

UNIT-III: Network Forensics

Introduction to WireShark, Introduction to TCPDump, investigating netrowk traffic, investigating network intrusions, study and analysis of benchmark network traffic dumps, analysis of cyber-attacks, understanding attack signature and behavior, router forensics.

UNIT-IV: Windows Systems and Artifacts

Windows Systems and Artifacts: Introduction, Windows File Systems, Master File Table, NTFS concept and analysis, File System Summary, Registry, Event Logs, USN Journal, Prefetch Files, JumpList, Shortcut Files, Program execution analysis.

UNIT-V: File indexing techniques and current trends in Database

Evaluating Computer Forensics Tool Needs, Introduction to Kali Linux, Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools, Tool Comparisons, Other Considerations for Tools, Computer Forensics Software Tools, Command-Line Forensics Tools, Other GUI Forensics Tools, Overview of Computer Forensics Hardware Tools, Forensic Workstations, Use Case of Write-Blocker Case Study: IoT device forensics, Drone Forensics, Smart TV Forensics, Gaming Console Forensics etc.

Text Books:

1. File System Forensic Analysis, by Brian Carrier Pearson Education.
2. Handbook of Digital Forensics and Investigation, Eoghan Casey, 1st edition, Academic Press.
3. Practical Linux Forensics: A Guide for Digital Investigators, by Bruce Nikkle, No Starch Press.

Reference Books:

1. Mangesh M. Ghonge, Sabyasachi Pramanik, Ramchandra Mangrulkar, Dac-Nhuong Le, “Cyber Security and Digital Forensics: Challenges and Future Trends”, Wiley- Scrivener.
2. Greg Gogolin, “Digital Forensics Explained”, CRC Press/Taylor & Francis Group, 2nd Edition.

CO-PO & PSO Correlation

Course Name: Digital Forensics and Malware								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3	3	2			3	3	3
CO2:	1	2	2			3	3	2
CO3:	2	2	2			2	2	3
CO4:			1			1	3	3
CO5:		3	2			1	3	1

Note: 1.: Low 2.: Moderate 3.: High

Scheme & Syllabus of M. Tech (CSE) Programme

Semester IV

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2 (L+T+P)
				L	T	P	PRE**		ESE*	Total Marks	
							Mid Sem	TA			
1	SOE-M-CSE-21-401	CSE	Dissertation	0	0	32	0	200	200	400	16
TOTAL				0	0	32	0	200	200	400	16

* End Semester Examination
** Progress Review Examination

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Programme	**:**	**M. Tech.**	**Semester**	**:**	**IV**
Name of the Course:		**Dissertation**	**Course Code:**		**SOE-M-CSE-21-401**
Credits	**:**	**16**	**No of Hours**	**:**	**32 Hrs./week**
Max Marks	**:**	**400**			

Course Description:

The project work can be an investigative analysis of a technical problem in the relevant area, planning and/or design project, experimental project or application based project on any of the topics. Each project will submit project synopsis by the end of the semester. Project evaluation committee consisting of three or four faculty members specialized in the various fields shall study the feasibility of each project work before giving consent.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain in-depth knowledge and use adequate methods in the major subject/field of study.
CO2	Create, analyze and critically evaluate different technical/research solutions
CO3	Clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings
CO4	Identify the issues that must be addressed within the framework of the specific dissertation in order to take into consideration
CO5	Apply principles of ethics and standards, skill of presentation and communication techniques.

Contents

Project work is of duration of one semesters and is expected to be completed in this semester. Each student is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The student is expected to fix their topics, complete preliminary studies like literature survey, field measurements etc. in the third semester.

Student shall study the topic of project work and define problem statement. The student shall evolve design and/or do experimental study and/or obtain solution to the identified problem. The student shall prepare a report and shall present a seminar on the basis of work done at the end of semester.

CO-PO & PSO Correlation

Course Name: Dissertation-Phase II								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3		2	2	3	3	3	3
CO2:	1		2	2	3	3	3	2
CO3:	2	2	2	1	2	2	2	3
CO4:		2	1	2	3	1	2	3
CO5:		3	2	3	3	1	3	1

Note: 1.: Low 2.: Moderate 3.: High