

**R25-COURSE STRUCTURE**  
**(M.TECH. DATA SCIENCE)**

**I SEMESTER**

SEMESTER									
S.No.	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	25DS01	Advanced Algorithms Analysis	3	1	0	4	40	60	100
2	25DS02	Data Science and its Applications	3	1	0	4	40	60	100
3	25DS03	Artificial Intelligence	3	1	0	4	40	60	100
4	PROGRAMELECTIVE-I		3	0	0	3	40	60	100
5	PROGRAMELECTIVE-II		3	0	0	3	40	60	100
Laboratory Courses									
6	25DS51	Advanced Algorithms analysis lab	0	1	2	2	40	60	100
7	25DS52	Data Science Applications using R/Python Lab	0	1	2	2	40	60	100
8	25PI01	Seminar-I	0	0	2	1	100	-	100
Total			15	5	6	23	380	420	800

**List of Professional Elective Courses in I Semester (Electives – I & II)**

Course Code	Course Title
25DS04	Massive Mining Datasets
25DS05	Full Stack Technologies
25DS06	Agile Methodologies
25DS07	Feature Engineering
25DS08	Cryptography and network Security
25DS09	Information Retrieval Systems
25DS10	Natural Language Processing
25DS11	Data Engineering

@ Minimum 2/3 themes per elective

**II SEMESTER**

S.No.	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	25DS12	Large Language Models	3	1	0	4	40	60	100
2	25DS13	Machine Learning	3	1	0	4	40	60	100
3	25DS14	Foundations to Data Analytics	3	1	0	4	40	60	100
4	Program Elective – III		3	0	0	3	40	60	100
5	Program Elective – IV		3	0	0	3	40	60	100
Laboratory Courses									
6	25DS53	Large Language Models Lab	0	1	2	2	40	60	100
7	25DS54	Machine Learning Lab	0	1	2	2	40	60	100
8	25PI02	Seminar – II	0	0	2	1	100	-	100
Total			15	5	6	23	380	420	800

**List of Professional Elective Courses in II Semester (Electives III & IV)**

S.No.	Course Title
25DS15	Deep Learning
25DS16	Database and Web Application Security
25DS17	Software Project Management
25DS18	Big Data Analytics
25DS19	Object Oriented Analysis & Design
25DS20	Quantum Computing
25DS21	Information Theory & coding
25DS22	Block Chain Technologies

@ Minimum 2/3 themes per elective

**III SEMESTER**

S.No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P			CIE	SEE
Theory Courses									
1	25RM01	Research Methodology and IPR / <i>Swayam 12 week MOOC course – RM&amp;IPR</i>	3	0	0	3	40	60	100
2	25PI03	Summer Internship/ Industrial Training (8-10 weeks)*	-	-	-	3	100	-	100
3	25PI04	Comprehensive Viva <sup>#</sup>	-	-	-	2	100		100
4	25PI05	Dissertation Part – A <sup>\$</sup>	-	-	20	10	100		100
Total			3	0	20	18	340	60	400

\*Student attended during summer / year break and assessment will be done in 3<sup>rd</sup> Sem.

# Comprehensive viva can be conducted courses completed upto second sem.

\$ Dissertation – Part A, internal assessment

**IV SEMESTER**

S.No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
1	25PI06	Dissertation Part – B <sup>%</sup>	-	-	32	16	-	100	100
<b>Total</b>			<b>0</b>	<b>0</b>	<b>32</b>	<b>16</b>	<b>0</b>	<b>100</b>	<b>100</b>

% External Assessment

**Total Credits: 23+23+18+16= 80**

M.Tech. (I Sem.)

**25DS01- ADVANCED ALGORITHMS  
ANALYSIS**

L	T	P	Cr.
3	1	0	4

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Analyze the complexity/performance of different algorithms.	L4
<b>CO2</b>	Determine the appropriate data structure for solving a particular set of problems.	L3
<b>CO3</b>	Categorize the different problems in various classes according to their complexity	L4
<b>CO4</b>	Discuss Dynamic Programming and Fast Fourier Transform algorithm	L4
<b>CO5</b>	Explain Linear Programming	L5

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	3	2	1
<b>CO2</b>	2		3	3	2	1
<b>CO3</b>	2	1	3		2	1
<b>CO4</b>	2	1		2	2	
<b>CO5</b>	2	1	3	3	2	2

**UNIT-I**

**Sorting:** Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

**UNIT-II**

**Matroids:** Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

**UNIT-III**

**Flow-Networks:** Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP decomposition.

**UNIT-IV**

**Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

## UNIT-V

**Linear Programming:** Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

## REFERENCES:

1. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms".
2. Aho, Hopcroft, Ullman "The Design and Analysis of Computer Algorithms".
3. Kleinberg and Tardos."Algorithm Design".

M. Tech. (I Sem.)

**25DS02- DATA SCIENCE AND ITS APPLICATIONS**

L	T	P	Cr.
3	1	0	4

**Pre-requisites:**

- **Course Educational Objective:** Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Produce Python code to statistically analyze a dataset.
- Critically evaluate data visualizations based on their design and use for communicating stories from data

**Course Outcomes:**

		Knowledge Level (K)#
<b>CO1</b>	Explain how data is collected, managed and stored for data science.	L3
<b>CO2</b>	Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.	L2
<b>CO3</b>	Discuss different Packages and how to use it	L5
<b>CO4</b>	Implement data collection and management scripts using Python Pandas.	L6

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes****Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	3	3	2
<b>CO2</b>	2	1	3	3	3	2
<b>CO3</b>	1	1	2	2	3	1
<b>CO4</b>	2	1	3	3	3	2

**UNIT-I**

**PYTHON Basics and Programming Concepts:** Introducing Python, Types and Operations -Numbers, Strings, Lists, Tuples, Dictionaries, Files, Numeric Types, Dynamic Typing; Statements and Syntax - Assignments, Expressions, Statements, Loops, iterations, comprehensions; Functions – Function Basics, Scopes, Arguments, Advanced Functions; Modules - Module Coding Basics, Module Packages, Advanced Module Topics; Classes and OOP - Class, Operator Overloading, Class Designing; Exceptions and Tools - Exception Basics,

**UNIT-II**

**GUI Programming: Graphical User Interface** - Python GUI development options, Adding Widgets, GUI Coding Techniques, Customizing Widgets; Internet Programming - Network Scripting, Client-Side scripting, Pymailgui client, server-side scripting, Pymailcgi server; Tools and Techniques - databases and persistence, data structures, text and language, python/c integration.

### **UNIT-III**

**Pandas and NumPy: Numpy Basics** - Fast Element wise array functions, Multidimensional Array, Data Processing using arrays, file i/o with arrays; **Pandas** - Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing.

### **UNIT-IV**

**Data Preprocessing:** Data Loading, Storage, and FileFormats - Reading and Writing data in text format, binary data formats, interacting with html and web apis, interacting with databases; **Data Wrangling:** Clean, Transform, Merge, Reshape - Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String Manipulation; **Data Aggregation and Group Operations** – Group by Mechanics, Data Aggregation, Groupby Operations and and Transformations, Pivot Tables and Cross Tabulation.

### **UNIT-V**

**Data Visualization:** A Brief matplotlib API Primer, Plotting Functions in pandas, Time Series, Financial and Economic Data Applications

### **Text Books:**

1. Learning Python , O'Reilly, Mark Lutz
2. Programming Python, O'Reilly, Mark Lutz
3. Python For Data Analysis ( O'Reilly, Wes McKinney)

### **Reference Books:**

1. Python: The Complete Reference, Martin C. Brown, McGraw Hill Education
2. Head First Python, Paul Barry, O'Reilly

## 25DS03-ARTIFICIAL INTELLIGENCE

M. Tech. ( I Sem.)

L	T	P	Cr.
3	1	0	4

## Course Outcomes:

		Knowledge Level (L)#
CO1	Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents	L3
CO2	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them	L3
CO3	Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.	L6
CO4	Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.	L2
CO5	Solve problems with uncertain information using Bayesian approaches	L2

## Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	3	2	1
CO2	3	1	3	3	3	2
CO3	3	1	3	3	3	2
CO4	3		3	3	3	2
CO5	3	1	3	3	3	3

## UNIT-I

**Introduction to artificial intelligence:** Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends in AI, Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening A\*, constraint satisfaction.

## UNIT-II

**Problem reduction and game playing:** Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games, Logic concepts: Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic

## UNIT-III

**Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames, advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.

## UNIT-IV

**Uncertainty measure:** probability theory: Introduction, probability theory, Bayesian belief networks (exact and approximate inference) certainty factor theory, Dempster-Shafer theory, non-monotonic reasoning, TMS.



## UNIT-V

**Expert systems:-** Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.

### Text Books:

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2. Artificial Intelligence, SarojKaushik, 1<sup>st</sup> Edition, CENGAGE Learning, 2011.

### Reference Books:

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Luger, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
3. Artificial Intelligence, A new Synthesis, 1<sup>st</sup> Edition, Nils J Nilsson, Elsevier, 1998
4. Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
5. Introduction To Artificial Intelligence And Expert Systems, 1<sup>st</sup> Edition, Patterson, Pearson India, 2015

M.Tech. (I Sem.)

**25DS04- MASSIVE MINING DATASETS**

L	T	P	Cr.
3	0	0	3

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Recollecting fundamentals of data mining	L2
<b>CO2</b>	Apply the concept of Map reduce and data streams for storing and processing of massive data sets	L3
<b>CO3</b>	Analyze the issues underlying the effective applications of massive data sets	L4
<b>CO4</b>	Evaluate different clustering algorithms and analyze various decomposition techniques	L4

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	1	1	2	2	2	1
<b>CO2</b>	2	1	3	3	3	2
<b>CO3</b>	3	1	3	3	3	2
<b>CO4</b>	3	1	3	3	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

**UNIT-I**

**Data Mining:** Introduction, Statistical Modeling, Machine Learning, Computational Approaches to Modeling, Feature Extraction, Statistical Limits on Data Mining, Hash Functions, Indexes, Natural Logarithms, Power Laws. (CO 1)

**UNIT-II**

**Map Reduce and the New Software Stack:** Distributed File Systems, Map Reduce, Algorithms Using Map Reduce, Extensions to Map Reduce, Complexity Theory for Map Reduce (CO 2)

**UNIT-III**

**Mining Data Streams:** The Stream Data Model, Sampling Data in aStream, Filtering Streams, Counting Distinct Elements in a Stream, Counting Ones in a Window, Decaying Windows. (CO 1, CO 2)

**UNIT-IV**

**Frequent Item sets:** The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream. (CO 1, CO 3)

**UNIT-V**

**Clustering:** Introduction to Clustering Techniques, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, and Clustering for Streams and Parallelism. Dimensionality Reduction: Eigen values and Eigenvectors of Symmetric Matrices, Principal-Component Analysis, Singular-Value Decomposition, CUR Decomposition (CO 1, CO 4).

**Text Books:**

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2<sup>nd</sup> Edition, Daniel Jurafsky, James H. Martin - Pearson Publication, 2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, O'Reilly Media, 2009.

**Reference Books:**

1. Language Processing with Java and Ling Pipe Cookbook, 1<sup>st</sup> Edition, Breck Baldwin, Atlantic Publisher, 2015.
2. Natural Language Processing with Java, 2<sup>nd</sup> Edition, Richard M Reese, O'Reilly Media, 2015.
3. Handbook of Natural Language Processing, Second, Nitin Indurkha and Fred J. Damerau, Chapman and Hall/CRC Press, 2010. Edition  
Natural Language Processing and Information Retrieval, 3<sup>rd</sup> Edition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008.

L	T	P	C
3	0	0	3

**Course Objectives:**

Translate user requirements into the overall architecture and implementation of new systems and Manage Project and coordinate with the Client.

- Write backend code in Python/Java, PHP languages and Writing optimized front end code HTML and JavaScript.
- Understand, create and debug database related queries and Create test code to validate the applications against client requirement.
- Monitor the performance of web applications & infrastructure and Troubleshooting web application with a fast and accurate a resolution

**Course Outcomes:** At the end of the

		Knowledge Level (K)#
<b>CO1</b>	Understand the architecture of the web,HTML5,CSS3,XML,DOM and related web standards and protoclos	K2
<b>CO2</b>	Apply JavaScript and AngularJS to create dynamic and responsive web applications	K3
<b>CO3</b>	Develop backend web applications using PHP and Node.js with form handling and database connectivity	K3
<b>CO4</b>	Perform database operations using MySQL and integrate it with frontend technologies using jQuery	K4
<b>CO5</b>	Demonstrate the use of MongoDB, deploy web applications, and implement web services using SOAP and RESTful APIs.	K5

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	2	2	1
<b>CO2</b>	2	1	3	3	2	2
<b>CO3</b>	3	1	3	3	3	2
<b>CO4</b>	2	1	3	3	3	2
<b>CO5</b>	2	2	3	3	3	3

**UNIT-I**

**Introduction to web-** Internet and world wide web, Domain name service, Protocols: HTTP, FTP, SMTP, Html5 concepts, CSS3, Anatomy of a web page, XML- Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches.

**UNIT-II**

**Javascript-** The Basics of Javascript: Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions, Angular JavaScript- AngularJS Expressions: ARRAY, Objects, \$eval, Strings, AngularJS Form Validation & Form Submission.

**UNIT-III**

**PHP Programming: Back – end-** Scripts PHP, Node js, Working with PHP- Using variables, Using constants, Data types, Operators. Conditional & Control statements, Arrays, functions. Working with forms and Databases such as MySQL, Node.js- Introduction, Advantages, Node.js Process Model, Node JS Modules.

#### UNIT-IV

**JQuery:** Introduction to JQuery, Syntax, Selectors & Events, MySQL: Practice MySQL Queries, Aggregate Functions, Regular Expressions, Joins & Unions, Sub-Queries, Database Connectivity with MySql.

#### UNIT-V

**Mongo DB-** Introduction, Architecture, Features, Examples, Database Creation & Collection in Mongo DB, Deploying Applications- Web hosting & Domains, Deployment Using Cloud Platforms, Web Services- SOAP, WSDL and RESTful Architecture.

#### Text Books:

1. Programming the World Wide Web, 7 th Edition, Robert W Sebesta, Pearson, 2013
2. Web Technologies, 1st Edition 7th impression, Uttam K Roy, Oxford, 2012.
3. Pro Mean Stack Development, 1 st Edition, Elad Elrom, Apress O'Reilly, 2016
4. JavaScript & jQuery the missing manual, 2 nd Edition, David sawyer mcfarland, O'Reilly, 2011
5. Web Hosting for Dummies, 1st Edition, Peter Pollock, John Wiley & Sons, 2013
6. RESTful web services, 1 st Edition, Leonard Richardson, Ruby, O'Reilly, 2007

#### Reference Books:

1. Ruby on Rails Up and Running, Lightning fast Web development, 1 st Edition, Bruce Tate, Curt Hibbs, Oreilly, 2006
2. Programming Perl, 4 th edition, Tom Christiansen, Jonathan Orwant, O'Reilly ,2012
3. Web Technologies, HTML& JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech, 2009
4. An Introduction to Web Design, Programming, 1 st Edition, Paul S Wang, Sanda S Katila, Cengage Learning, 2003

**Web Reference Links:** 1. <http://www.upriss.org.uk/perl/PerlCourse.html>

M.Tech. (I Sem.)

**25DS06- AGILE METHODOLOGIES  
(PROGRAM ELECTIVE-II)**

L	T	P	Cr.
3	0	0	3

**Course Objectives:** This course is aimed at enabling the students to

1. The main objectives of this course are to introduce the important concepts of Agile software development Process, emphasize the role of stand-up meetings in software collaboration, impart the knowledge on values and principles in understanding agility
- 2.

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Understand the core values and mindset of Agile Methodology for effective project development	L1
<b>CO2</b>	Explain Agile Principles and apply them in Agile Project management practices	L3
<b>CO3</b>	Describe Key concepts of XP, Simplicity, and Incremental Design	L2
<b>CO4</b>	Apply Lean Principles to identify and Eliminating Waste in software processes	L4

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	2	2	1
<b>CO2</b>	2	2	3	2	3	2
<b>CO3</b>	2	1	2	2	2	1
<b>CO4</b>	3	1	3	3	3	2

**UNIT-I**

**Learning Agile:** Getting Agile into your brain, Understanding Agile values, No Silver Bullet, Agile to the Rescue, adding Agile makes a difference. A fractured perspective, How a fractured perspective causes project problems. The Agile Manifesto, Purpose behind Each Practice. Individuals and Interactions Over Processes and Tools, Working Software over Comprehensive Documentation, Customer Collaboration over Contract Negotiation, Responding to Change over Following a Plan, Principles over Practices. Understanding the Elephant, Methodologies Help You Get It All in Place at Once, Where to Start with a New Methodology

**UNIT-II**

**The Agile Principles:** The 12 Principles of Agile Software, The Customer Is Always Right, “Do As I Say, Not As I Said”. Delivering the Project, Better Project Delivery for the Ebook Reader Project. Communicating and Working Together, Better Communication for the Ebook Reader Project. Project Execution—Moving the Project Along, A Better Working Environment for the Ebook Reader Project Team. Constantly Improving the Project and the Team. The Agile Project: Bringing All the Principles Together

**UNIT-III**

**SCRUM and Self-Organizing Teams:** The Rules of Scrum, Act I: I Can Haz Scrum?, Everyone on a Scrum Team owns the Project, The Scrum Master Guides the Team's Decisions, The Product Owner Helps the Team Understand the Value of the Software, Everyone Owns the Project, Scrum Has Its Own Set of Values ,Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection-Adaptation Cycle, The Last Responsible Moment, How to Hold an Effective Daily Scrum. Sprinting into a Wall, Sprints, Planning, and Retrospectives, Iterative or Incremental?, The Product Owner Makes or Breaks the Sprint, Visibility and Value, How to Plan and Run an Effective Scrum Sprint

**Scrum Planning And Collective Commitment:** Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Make Your Software Useful, User Stories Help Build Features Your Users Will Use, Conditions of Satisfaction, Story Points and Velocity, Burndown Charts, Planning and Running a Sprint Using Stories, Points, Tasks, and a Task Board. Victory Lap, Scrum Values Revisited, Practices Do Work Without the Values (Just Don't Call ItScrum), Is Your Company's Culture Compatible with Scrum Values.

**UNIT-IV**

**XP And Embracing Change:** Going into Overtime, The Primary Practices of XP, Programming Practices, Integration Practices, Planning Practices, Team Practices, Why Teams Resist Changes, and How the Practices Help. The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, XP Helps Developers Learn to Work with Users, Practices Only "Stick" When the Team Truly Believes in Them, An Effective Mindset Starts with the XP Values, The XP Values, Paved with Good Intentions. The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change, The Principles of XP, XP Principles Help You Understand Planning, XP Principles Help You Understand Practices— and Vice Versa, Feedback Loops.

**XP, Simplicity, and Incremental Design:** Code and Design, Code Smells and Antipatterns (or, How to Tell If You're Being Too Clever),

XP Teams Look for Code Smells and Fix Them, Hooks, Edge Cases, and Code That Does Too Much. Make Code and Design Decisions at the Last Responsible Moment, Fix Technical Debt by Refactoring Mercilessly, Use Continuous Integration to Find Design Problems, Avoid Monolithic Design, Incremental Design and the Holistic XP Practices. Teams Work Best When They Feel Like They Have Time to Think, Team Members Trust Each Other and Make Decisions Together. The XP Design, Planning, Team, and Holistic Practices Form an Ecosystem Incremental Design Versus Designing for Reuse, When Units Interact in a Simple Way, the System Can Grow Incrementally, Great Design Emerges from Simple Interactions, Final Score

**UNIT-V**

**Lean, Eliminating Waste, and Seeing the whole:** Lean Thinking, Commitment, Options Thinking, and Set-Based Development, Creating Heroes and Magical Thinking. Eliminate Waste, Use a Value Stream Map to Help See Waste Clearly, Gain a Deeper Understanding of the Product, See the Whole, Find the Root Cause of Problems That You Discover. Deliver As Fast As Possible, Use an Area Chart to Visualize Work in Progress, Control Bottlenecks by Limiting Work in Progress.

**Kanban, Flow, and Constantly Improving:** The Principles of Kanban, Find a Starting Point and Evolve Experimentally from There. Stories Go into the System; Code Comes Out, Improving Your Process with Kanban, Visualize the Workflow, Limit Work in Progress. Measure and Manage Flow, Managing Flow with WIP Limits Naturally Creates Slack. Make Process Policies Explicit So Everyone Is on the Same Page. Emergent Behavior with Kanban.

**The Agile Coach:** Coaches Understand Why People Don't Always Want to Change. The Principles of Coaching.

**Text Books:**

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

**Reference Books:**

1. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.
2. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley, 2013



M.Tech. (I Sem.)

**25DS07- FEATURE ENGINEERING  
(PROGRAM ELECTIVE-III)**

L	T	P	Cr.
3	0	0	3

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Describe the Basic concepts of Data, Tasks, Models, Features and Model building	L2
<b>CO2</b>	Explain the concept of converting Text into Flat Vectors using Bag- of- Words, and Bag-of-n-Grams	L3
<b>CO3</b>	Demonstrate techniques for Dimensionality Reduction	L4
<b>CO4</b>	Discuss non linear Featurization	L4
<b>CO5</b>	Explain the concept of Item-Based Collaborative Filtering	L3

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	3	2	1
<b>CO2</b>	2	1	3	3	3	2
<b>CO3</b>	3	1	3	3	3	2
<b>CO4</b>	2	1	3	3	3	2
<b>CO5</b>	3	1	3	3	3	2

**UNIT-I**

**The Machine Learning Pipeline:** Data, Tasks, Models, Features, Model Evaluation Fancy Tricks with Simple Numbers: Scalars, Vectors, and Spaces, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Log Transform in Action, Power Transforms: Generalization of the Log Transform, Feature Scaling or Normalization, Min-Max Scaling, Standardization (Variance Scaling),  $\ell_2$  Normalization, Interaction Features, Feature Selection

**UNIT-II**

**Text Data: Flattening, Filtering, and Chunking: Bag-of-X:** Turning Natural Text into Flat Vectors, Bag- of- Words, Bag-of-n-Grams, Filtering for Cleaner Features: Stopwords, Frequency-Based Filtering, Stemming; Atoms of Meaning: From Words to n-Grams to Phrases: Parsing and Tokenization, Collocation Extraction for Phrase Detection The Effects of Feature Scaling: From Bag-of-Words to Tf-Idf :Tf-Idf :A Simple Twist on Bag-of- Words, Putting It to the Test : Creating a ClassificationDataset,Scaling Bag-of-Words with Tf-Idf Transformation, Classification with Logistic Regression, Tuning Logistic Regression with Regularization

**UNIT-III**

**Categorical Variables:** Counting Eggs in the Age of Robotic Chickens: Encoding Categorical Variables: One-Hot Encoding, Dummy Coding, Effect Coding, Pros and Cons of Categorical Variable Encodings; Dealing with Large Categorical Variables: Feature Hashing, Bin Counting. **Dimensionality Reduction:** Squashing the Data Pancake with PCA: Intuition, Derivation: Linear Projection, Variance and Empirical Variance, Principal Components: First Formulation, Principal Components: Matrix-Vector Formulation, General Solution of the Principal Components; Transforming Features, Implementing PCA: PCA in Action, Whitening and ZCA, Considerations and Limitations of PCA

#### UNIT-IV

**Nonlinear Featurization via K-Means Model Stacking:** k-Means Clustering, Clustering as Surface Tiling, k-Means Featurization for Classification: Alternative Dense Featurization, Pros, Cons, and Gotchas

#### UNIT-V

**Item-Based Collaborative Filtering, First Pass:** Data Import, Cleaning, and Feature Parsing, Academic Paper Recommender: Naive Approach, Second Pass: More Engineering and a Smarter Model, Academic Paper Recommender: Take 2, Third Pass: More Features is More Information, Academic Paper Recommender: Take 3

\*Note:

#### Text Books:

1. “Feature Engineering for Machine Learning Principles and Techniques for Data Scientists”, Alice Zheng & Amanda Casari, O’REILLY, 2018
2. “Feature Engineering and Selection: A Practical Approach for Predictive Models”, Max Kuhn, Kjell Johnson, CRC Press, 2019

M.Tech. (I Sem.)

**25DS08- CRYPTOGRAPHY & NETWORK  
SECURITY (PROGRAM ELECTIVE-III)**

L	T	P	Cr.
3	0	0	3

**COURSE OBJECTIVES:**

- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand the basic categories of threats to computers and networks
- Discusses the Mathematics of Cryptography
- Discuss the fundamental ideas of Symmetric and Asymmetric Cryptographic Algorithms
- Discusses the Network layer, Transport Layer and Application Layer Protocols Enhanced security mechanisms

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

CO	Course Outcomes	Knowledge Level (L)#
CO1	Understand security issues related to computer networks and learn different symmetric key techniques	L2
CO2	Apply mathematic of cryptography for symmetric and Asymmetric algorithms and apply this knowledge to understand the Cryptographic algorithms	L3
CO3	Describe different types of symmetric and Asymmetric algorithms	L2
CO4	Apply algorithms of Hash functions, message authentication and digital signature and their importance to the security	L3
CO5	Explore enhanced security protocols of Application Layer, Transport Layer and Network layer	L6

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	2	2	1
CO2	3	1	3	3	3	2
CO3	2	1	3	2	2	1
CO4	3	1	3	3	3	2
CO5	3	1	3	3	3	2

**UNIT-I**

**Security Concepts:** Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography. Classical Encryption Techniques-symmetric cipher model, Substitution techniques, Transposition techniques, RotorMachines, Steganography.

**UNIT-II**

**Introduction to Symmetric Cryptography: Algebraic Structures-** Groups, Rings, Fields,  $GF(2^n)$  fields, Polynomials.**Mathematics of Asymmetric cryptography:** Primes, Checking For Primness, Eulers phi-functions, Fermat's Little Theorem, Euler's Theorem, Generating Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation And Logarithm.

### UNIT-III

**Symmetric key Ciphers:** Block Cipher principles, DES, AES, Blowfish, IDEA, Block cipher operation, Stream ciphers: RC4, RC5 **Asymmetric key Ciphers:** Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.

### UNIT-IV

**Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithms (SHA)

**Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MAC'S, MAC'S Based On Hash Functions: HMAC, MAC'S Based On Block Ciphers: DAA And CMAC

**Digital Signatures:** Digital Signatures, Elgamal Digital Signature Scheme, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

### UNIT-V

**Network and Internet Security: Transport-Level Security:** Web Security Considerations, Transport Level Security, HTTPS, SSH.

**IP Security:** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Authentication Header Protocol.

**Electronic-Mail Security:** Internet-mail Security, Email Format, Email Threats and Comprehensive Email Security, S/MIME, PGP.

### TEXT BOOKS:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 7th Edition, 2017
- Cryptography and Network Security: Behrouz A. Forouzan Debdeep, Mc Graw Hill

### Reference Books:

1. Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi.
2. Atul Kahate (2008), Cryptography and Network Security, 2nd edition, Tata Mc Grawhill, India.
- Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata Mc Grawhill, India.

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**25DS09- INFORMATION RETRIEVAL  
SYSTEMS**

L	T	P	Cr.
3	0	0	3

**Course Outcomes:**

		Knowledge Level (K)#
<b>CO1</b>	Understand the fundamentals of Information Retrieval (IR) systems, including domain analysis and system evaluation	L2
<b>CO2</b>	Apply appropriate data structures and algorithms for indexing and retrieval in IR systems	L3
<b>CO3</b>	Analyze various text indexing techniques like Inverted Files, Signature Files, and PAT Trees	L4
<b>CO4</b>	Evaluate stemming algorithms and methods for thesaurus construction in IR systems	L5
<b>CO5</b>	Implement and compare different string searching algorithms used in IR	L4

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	2	2	1
<b>CO2</b>	3	1	3	3	3	2
<b>CO3</b>	3	1	3	3	3	2
<b>CO4</b>	3	1	3	3	3	2
<b>CO5</b>	3	1	3	3	3	2

**UNIT-I**

**Introduction to Information storage and retrieval systems:** Domain Analysis of IR systems, IR and other types of Information Systems, IR System Evaluation

**Introduction to Data structures and algorithms related to Information Retrieval:** Basic Concepts, Data structures, Algorithms.

**UNIT-II**

**Inverted Files and Signature Files:** Introduction, Structures used in Inverted Files, Building an Inverted file using a sorted array, Modifications to the Basic Techniques.

**Signature Files:** Concepts of Signature files, Compression, Vertical Partitioning, Horizontal Partitioning.

**UNIT-III**

**New Indices for Text, Lexical Analysis and Stoplists: PAT Trees and PAT Arrays:** Introduction, PAT Tree structure, Algorithms on the PAT Trees, Building PAT Trees as PATRICA Trees, PAT representation as Arrays. Stoplists.

**UNIT-IV**

**Stemming Algorithms and Thesaurus Construction:** Types of Stemming algorithms, Experimental Evaluations of Stemming, Stemming to Compress Inverted Files.

**Thesaurus Construction:** Features of Thesauri, Thesaurus Construction, Thesaurus construction from Texts, Merging existing Thesauri.

**UNIT-V**

**String Searching Algorithms:** Introduction, Preliminaries, The Naive Algorithm, The Knutt-Morris-Pratt Algorithm, The Boyer-Moore Algorithm, The Shift-Or Algorithm, The Karp-Rabin Algorithm.

**TEXT BOOKS**

1. Modern Information Retrieval, Ricardo Baeza-Yates, Neto, PEA, 2007.
2. Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark Academic Press, 2000.

**M.Tech. (I Sem.) 25DS10-NATURAL LANGUAGE PROCESSING**

L	T	P	Cr.
3	0	0	3

**Course Objectives:** This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Demonstrate a given text with basic Language features	L3
<b>CO2</b>	Design an innovative application using NLP components	L6
<b>CO3</b>	Explain a rule based system to tackle morphology/syntax of a language	L2
<b>CO4</b>	Design a tag set to be used for statistical processing for real-time applications	L6
<b>CO5</b>	Compare and contrast the use of different statistical approaches for different types of NLP applications	L4

*#Based on suggested Revised BTL*

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	3	2	2
<b>CO2</b>	3	2	3	3	3	3
<b>CO3</b>	2	1	3	3	2	1
<b>CO4</b>	3	2	3	3	3	2
<b>CO5</b>	3	1	3	3	3	2

### 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:**

3. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2<sup>nd</sup> Edition, Daniel Jurafsky, James H. Martin - Pearson Publication, 2014.
4. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, O'Reilly Media, 2009.

##### **Reference Books:**

4. Language Processing with Java and Ling Pipe Cookbook, 1<sup>st</sup> Edition, Breck Baldwin, Atlantic Publisher, 2015.
5. Natural Language Processing with Java, 2<sup>nd</sup> Edition, Richard M Reese, O'Reilly Media, 2015.
6. Handbook of Natural Language Processing, Second, Nitin Indurkha and Fred J. Damerau, Chapman and Hall/CRC Press, 2010. Edition  
Natural Language Processing and Information Retrieval, 3<sup>rd</sup> Edition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008.



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25DS11- DATA ENGINEERING

L	T	P	Cr.
3	0	0	3

**Course Outcomes:**

		Knowledge Level (L)#
<b>CO1</b>	Understand Data Engineering Life cycle	L2
<b>CO2</b>	Apply appropriate data modeling techniques for different types of data. (L3).	L3
<b>CO3</b>	Evaluate and select appropriate technologies and frameworks for specific data engineering tasks	L5
<b>CO4</b>	Implement data quality checks and governance processes to ensure data reliability and compliance.	L3

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	3	2	1
<b>CO2</b>	3	1	3	3	3	2
<b>CO3</b>	2	2	3	3	3	2
<b>CO4</b>	3	2	3	3	3	3

**UNIT-I**

**Introduction to Data Engineering:** Definition, Data Engineering Life Cycle, Evolution of Data Engineer, Data Engineering Versus Data Science, Data Engineering Skills and Activities, Data Maturity, Data Maturity Model, Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, Data Engineers and Other Technical Roles

**UNIT-II**

**Data Engineering Life Cycle:** Data Life Cycle Versus Data Engineering Life Cycle, Generation: Source System, Storage, Ingestion, Transformation, Serving Data. Major undercurrents across the Data Engineering Life Cycle: Security, Data Management, DataOps, Data Architecture, Orchestration, Software Engineering.

**UNIT-III**

**Designing Good Data Architecture:** Enterprise Architecture, Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts. Data Generation in Source Systems: Sources of Data, Files and Unstructured Data, APIs, Application Databases (OLTP), OLAP, Change Data Capture, Logs, Database Logs, CRUD, Source System Practical Details.

**UNIT-IV**

**Storage:** Raw Ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Data warehouse, Data Lake, Data Lakehouse. Ingestion: Data Ingestion, Key Engineering considerations for the Ingestion Phase, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ing

**UNIT-V**

**Queries, Modeling and Transformation:** Queries, Life of a Query, Query Optimizer, Queries on Streaming Data, Data Modelling, Modeling Streaming Data, Transformations, Streaming Transformations and Processing. Serving Data for Analytics, Machine Learning and Reverse ETL: General Considerations for serving Data, Business Analytics, Operational Analytics, Embedded Analytics, Ways to serve data for analytics and ML, Reverse ETL.

**Textbooks:**

1. Joe Reis, Matt Housley, Fundamentals of Data Engineering, O'Reilly Media, Inc., June 2022, ISBN: 9781098108304

**Reference Books:**

1. Paul Crickard , Data Engineering with Python, Packt Publishing, October 2020.
2. Ralph Kimball, Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley, 3rd Edition, 2013
3. James Densmore, Data Pipelines Pocket Reference: Moving and Processing Data for Analytics, O'Reilly Media, 1st Edition, 2021

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**25DS51- ADVANCED ALGORITHMS  
ANALYSIS LAB**

L	T	P	Cr.
0	1	2	2

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**List of Experiments:**

1. Implement assignment problem using Brute Force method
2. Perform multiplication of long integers using divide and conquer method.
3. Implement a solution for the knapsack problem using the Greedy method
4. Implement Gaussian elimination method.
5. Implement LU decomposition
6. Implement Warshall algorithm
7. Implement the Rabin Karp algorithm.
8. Implement the KMP algorithm.
9. Implement Harspool algorithm
10. Implement max-flow problem.

**Text Book:**

1. Design and Analysis of Algorithms, S.Sridhar, OXFORD University Press

**References Books**

1. Introduction to Algorithms, second edition, T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, PHI Pvt. Ltd./ Pearson Education.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharam, Universities Press.
3. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education

**M. Tech. (I Sem.)****25DS52- DATA SCIENCE APPLICATIONS USING  
R/PYTHON LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr.</b>
<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>

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**List of Experiments**

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1. Write a Python Program to Find the Sum of the Series:  $1 + 1/2 + 1/3 + \dots + 1/N$
2. Write a Python Program to Split the array and add the first part to the end
3. Write a Python Program to Create a List of Tuples with the First Element as the Number and Second Element as the Square of the Number
4. Write a Python program to count number of vowels using sets in given string
5. Write a program to implement permutation of a given string using inbuilt function.
6. Write a python program to sort list of dictionaries by values in Python – Using lambda function
7. Write a Python Program for following sorting:
  - i. Quick Sort
  - ii. Heap Sort
8. Write a Python Program to Reverse a String Using Recursion
9. Write a Python Program to Count the Number of Words in a Text File
10. Write a Python Program to Read the Contents of a File in Reverse Order
11. Write a program to Merge and Join DataFrames with Pandas in Python
12. Write a program to implement Merge and Join DataFrames with Python Pandas
13. Write a Python Program to Append the Contents of One File to Another File
14. How to install and Load CSV files to Python Pandas
15. Write a program to implement Data analysis and Visualization with Python using pandas
16. Write a program to Implement Plotting Functions in python pandas.

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25DS12- LARGE LANGUAGE MODELS

L	T	P	Cr.
3	1	0	4

**Course Outcomes:**

		Knowledge Level (L)#
<b>CO1</b>	Explore the concept of Language Modeling Techniques and Implement the AND,OR and XOR logic	L3
<b>CO2</b>	Discuss the different types of Word Embedding	L2
<b>CO3</b>	Explain the concept transformer decoding blocks	L2
<b>CO4</b>	Discuss the concept of Pretraining Applications and Limitations	L4
<b>CO5</b>	Demonstrate the concept of Handling Memory for LLM Agents	L3

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	3	3	2
<b>CO2</b>	2	1	3	2	2	1
<b>CO3</b>	2	1	3	3	3	2
<b>CO4</b>	3	2	3	3	3	2
<b>CO5</b>	3	2	3	3	3	2

**UNIT-I**

**Introduction-** What is a Language Model?, Evolution of Language Modelling Technologies, Scaling Laws in Language Models, Evolution of LLMs, The Emergence and Development of LLMs, Implications of Encoder-Decoder in LLM Development, Optimising Scale and Resource Efficiency in LLMs **Neural Networks:** The Perceptron, Definition, Implementing AND, OR, and XOR Logic, Multilayer Perceptron, Neural Networks, Types of Activation Functions.

**UNIT-II**

**Word Embedding-**Distributional Hypothesis, Vector Semantics, Defining and Measuring Semantic Similarity, Types of Word Embedding, Frequency-Based Embeddings, Word2Vec, Global Vectors for Word Representation, Fast Text, Bias in Word Embedding, Limitations of Word Embedding Methods, Applications of Word Embeddings.

**UNIT-III**

**Transformers-** Self-Attention, Multi-Head Self-Attention, Transformer Encoder Block, Components of the Transformer Encoder Block, Feed-Forward Neural Network, Layer Normalisation, Residual Connections, Transformer Decoder Block, Masked Multi-Head Self-Attention, Cross-Attention (Encoder-Decoder Attention), Positional Embeddings, Types of Positional Embeddings, Rotary Position Embedding, EfficientAttention Mechanisms,

**UNIT-IV**

**Language Model Pretraining-** Embeddings from Language Model, Architecture and Training of ELMo, Applications of ELMo, Limitations of ELMo, Evaluation Datasets, Encoder-Based Pretraining, Fundamentals of Encoder-Based Models, Training Paradigm, BERT Pretraining, Applications and Limitations, Decoder-Based Pretraining, Decoder-Based Architecture, Training Paradigm,GPT Pretraining, Applications and Limitations, Encoder-Decoder Based Pretraining, Architecture, Joint Pretraining Strategy,T Pretraining, Applications and Limitations, Emergence of Large Language Models, Limitations of Pretraining.

## UNIT-V

**Augmented Large Language Models- Retrieval-Augmented Generation**, Indexing in RAGs, Context Searching in RAGs, Prompting in RAGs, Inferencing in RAGs, Comparison of RAGs with LLMs, Evaluation of RAGs, Assessing of Retrieval Quality, Generation Quality, Knowledge Integration and Factuality Evaluation, Response Time and Efficiency, User Satisfaction, RAGAs Framework for RAG Evaluation, Tool Calling with LLMs, Autonomously Determining Which Tools to Use and Where, Examples of Different Tools, Evaluation of Code Generation Capabilities of Agents, Error Handling and Optimisation, LLM Augmentation with Agents, Reasoning in LLM Agents, Planning in LLM Agents, Handling Memory in LLM Agents

### Text Books:

1. “Introduction to Large Language Models” Generative AI for Text by Tanmoy Chakraborty-25 December 2024, Wiley Publications.

M. Tech. (II Sem.)

25DS13- MACHINE LEARNING

L	T	P	Cr.
3	1	0	4

**Course Outcomes:**

		Knowledge Level (L)#
<b>CO1</b>	Enumerate the Fundamentals of Machine Learning	L1
<b>CO2</b>	Build Nearest neighbour based models	L3
<b>CO3</b>	Apply Models based on decision trees and Bayes rule	L3
<b>CO4</b>	Choose appropriate clustering technique	L4
<b>CO5</b>	Determine algorithms to generate code for a target machine	L5

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	1	3	2	2	1
<b>CO2</b>	2	1	3	3	3	2
<b>CO3</b>	3	2	3	3	3	2
<b>CO4</b>	3	2	3	3	3	2
<b>CO5</b>	3	2	3	3	3	2

**UNIT-I**

**Introduction to Machine Learning:** Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

**UNIT-II**

**Nearest Neighbor-Based Models:** Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

**UNIT-III**

**Models Based on Decision Trees:** Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.**The Bayes Classifier:** Introduction to the Bayes Classifier, Bayes’ Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

**UNIT-IV**

**Linear Discriminants for Machine Learning:** Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

## UNIT-V

**Clustering** : Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

### Text Books:

2. “Machine Learning Theory and Practice”, M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

### Reference Books:

1. “Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017
2. “Machine Learning in Action”, Peter Harrington, DreamTech
3. “Introduction to Data Mining”, Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019



L	T	P	Cr.
3	1	0	4

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (K)#
<b>CO1</b>	Understand the impact of data analytics for business decisions and strategy Carry out data analysis/statistical analysis	L1
<b>CO2</b>	Discover interesting patterns, analyze supervised and unsupervised and estimate the accuracy of the algorithms.	L2
<b>CO3</b>	Understand the various search methods and visualization techniques	L1
<b>CO4</b>	Determine algorithms to generate code for a target machine	L3

#Based on suggested Revised BTL

### Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	1	3	2	2	1
<b>CO2</b>	2	1	3	3	3	2
<b>CO3</b>	3	1	3	3	3	2
<b>CO4</b>	3	2	3	3	3	2
<b>CO5</b>	3	2	3	3	3	2

### UNIT-I

**Data Management:** Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/Signals/GPS etc. Data Management, Data Quality(noise, outliers, missing values, duplicate data) and Data Processing & Processing

### UNIT-II

**Data Analytics:** Introduction to Analytics, Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables, Data Modeling Techniques, Missing Imputations etc. Need for Business Modeling.

### UNIT-III

**Regression** – Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc. Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

### UNIT-IV

**Object Segmentation:** Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and Complexity, Multiple Decision Trees etc. Time Series Methods: Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average Energy etc and Analyze for prediction

### UNIT-V

**Data Visualization:** Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

**TEXT BOOKS:**

1. Student's Handbook for Associate Analytics – II, III.
2. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers.

**REFERENCE BOOKS:**

4. Introduction to Data Mining, Tan, Steinbach and Kumar, Addison Wesley, 2006.
3. Data Mining Analysis and Concepts, M. Zaki and W. Meira
4. Mining of Massive Datasets, Jure Leskovec Stanford Univ. Anand Rajaraman Millway Labs  
Jeffrey D Ullman Stanford Univ.

M. Tech (II Sem)

25DS15- DEEP LEARNING

L	T	P	Cr.
3	0	0	3

**Course Objectives:**

- The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short-term memory cells and convolution neural networks.

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Understand basic concepts of biological and computational neurons, perceptron models, and learning algorithms.	L2
<b>CO2</b>	Apply feedforward neural networks and optimization algorithms like backpropagation, gradient descent, and auto encoders.	L3
<b>CO3</b>	Analyze and evaluate modern optimization methods and regularization techniques to train better deep networks	L4
<b>CO4</b>	Apply advanced neural network architectures such as RNNs, LSTMs, CNNs, and RBMs to sequence and image data	L3
<b>CO5</b>	Evaluate and compare recent deep learning trends including transformers, GPTs, and their applications in NLP, vision, and speech	L5

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	2	2	2	1	1
<b>CO2</b>	3	2	3	3	3	2
<b>CO3</b>	3	2	3	3	3	2
<b>CO4</b>	3	2	3	3	3	2
<b>CO5</b>	3	2	2	3	3	3

**UNIT-I**

**Basics-** 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**

**Feed forward Networks-**Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders.

**Deep Neural Networks:** Difficulty of training deep neural networks, Greedy layer wise training

**UNIT-III**

**Better Training of Neural Networks-**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 Networks-** Back propagation through time, Long Short-Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines

(RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

**UNIT-V**

**Recent trends-** Variational Autoencoders, Transformers, GPT Applications: Vision, NLP, Speech

**Text Books:**

1. Deep Learning, Ian Good fellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016

**Reference Books:**

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

**M.Tech. (II Sem.)      25DS16- DATABASE AND WEB APPLICATION SECURITY**

L	T	P	Cr.
3	0	0	3

**Course Objectives:**

1. To acquire knowledge on standard algorithms used to provide confidentiality,
2. integrity and authenticity.
3. To design security applications in the field of Information technology.
4. To understand the fundamentals of database design, DB security and SQL extensions to security.
5. extensions to security.
6. To learn the basic concepts of Penetration testing.

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Explain the fundamental concepts of database security, threats, access control models, and inference attacks	L2
<b>CO2</b>	Apply access control mechanisms and analyze SQL injection vulnerabilities in relational and distributed databases	L3
<b>CO3</b>	Evaluate security issues in web applications and implement security measures based on OWASp standards	L4
<b>CO4</b>	Analyze mobile device security threats and apply software and hardware-centric security techniques.	L4
<b>CO5</b>	Apply penetration testing methods and tools to identify and mitigate application and system vulnerabilities.	L3

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	2	1			1
<b>CO2</b>	3	3	2	2	2	
<b>CO3</b>	3	3	3	3	3	1
<b>CO4</b>	2	2	2	3	3	
<b>CO5</b>	2	3	3	3	3	1

**UNIT-I**

**Database Security**-Introduction includes threats, vulnerabilities and breaches, Basics of database design, DB security, concepts, approaches and challenges, types of access controls, Oracle VPD, Discretionary and Mandatory access control: Principles, applications and poly instantiation, Database inference problem, types of inference attacks, distributed database, security levels, SQL-injection: types and advanced concepts

**UNIT-II**

**Relational Data Model**- Security in relational data model, concurrency controls and locking, SQL extensions to security (oracle as an example), System R concepts, Context and control based access control, Hippocratic databases, Database watermarking, Database intrusion, Secure data outsourcing.

**UNIT-III**

**Web application security**-Basic principles and concepts, Authentication, Authorization, Browser security principles; XSS and CSRF, same origin policies, File security principles, Secure development and deployment methodologies, Web DB principles, OWASP – Top 10 -Detailed treatment, IoT security.

#### **UNIT-IV**

**Mobile device security:** Introduction, attack vector and models, hardware centric security aspects, SMS / MMS vulnerabilities, software centric security aspects, mobile web browser security, Application security: Concepts, CIA Triad, Hexad, types of cyber- attacks, Introduction to software development vulnerabilities, code analyzers– Static and dynamic analyzers.

#### **UNIT-V**

**Penetration testing-** Principles and concepts, PT work flows and examples, blind tests, ethical hacking techniques, synthetic transactions, interface testing and fuzzing, SDLC phases and security mandates.

#### **Text Books:**

1. Web Application Security, 1st Edition, A Beginners Guide, Bryan and Vincent, McGraw- Hill, 2011
2. Database Security, 1st Edition, Alfred Basta, Melissa Zgola, Course Technology, 2012

#### **Reference Books:**

1. Handbook of Database Security: Applications and Trends, Michael Gertz and Sushil Jajodia, Springer, 2008
2. Database and Applications Security, 1st Edition, Integrating Information Security and Data Management, Bhavani Thuraisingham, Auerbach Publications, 2005

L	T	P	Cr.
3	0	0	3

M.Tech. (II Sem.)

25DS17- SOFTWARE PROJECT MANAGEMENT

**Course Objectives:**

At the end of the course, the student shall be able to:

- To describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project
- To compare and differentiate organization structures and project structures
- To implement a project to manage project schedule, expenses and resources with the application of suitable project management tools

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Explain conventional and modern software management principles and improvements in software economics.	L2
<b>CO2</b>	Describe life cycle phases and process artifacts used in software development and management	L2
<b>CO3</b>	Apply iterative planning, work breakdown structures, cost/schedule estimation, and model-based architectures.	L3
<b>CO4</b>	Analyze project organization structures, automation tools, and process instrumentation using metrics.	L4
<b>CO5</b>	Evaluate and apply Agile and DevOps principles, practices, and tools in modern software development.	L4

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	2	2	2		1
<b>CO2</b>	3	2	2	2	1	
<b>CO3</b>	3	3	3	3	2	
<b>CO4</b>	2	3	3	3	3	
<b>CO5</b>	2	2	3	3	2	1
<b>CO6</b>						

**UNIT-I**

**Conventional Software Management:** The waterfall model, conventional software Management performance.

**Evolution of Software Economics:** Software Economics, pragmatic software cost estimation.

**Improving Software Economics:** Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.

**The old way and the new:** The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

**UNIT-II**

**Life cycle phases:** Engineering and production stages, inception, Elaboration, construction, transition phases.

**Artifacts of the process:** The artifact sets, Management artifacts, Engineering artifacts, programatic artifacts.

### UNIT-III

**Model based software architectures:** A Management perspective and technical perspective.

**Work Flows of the process:** Software process workflows, Iteration workflows.

**Checkpoints of the process:** Major mile stones, Minor Milestones, Periodic status assessments.

**Iterative Process Planning:** Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

### UNIT-IV

**Project Organizations and Responsibilities:** Line-of-Business Organizations, Project Organizations, evolution of Organizations.

**Process Automation:** Automation Building blocks, The Project Environment.

**Project Control and Process instrumentation:** The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.

### UNIT-V

Agile Methodology, ADAPTING to Scrum, Patterns for Adopting Scrum, Iterating towards Agility.

**Fundamentals of DevOps:** Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system. DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes

#### Text Books:

1. Software Project Management, Walker Royce, PEA, 2005.
2. Succeeding with Agile: Software Development Using Scrum, Mike Cohn, Addison Wesley.
3. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim , John Willis , Patrick Debois , Jez Humb, 1st Edition, O'Reilly publications, 2016.

#### Reference Books:

1. Software Project Management, Bob Hughes, 3/e, Mike Cotterell, TMH
2. Software Project Management, Joel Henry, PEA
3. Software Project Management in practice, Pankaj Jalote, PEA, 2005,
4. Effective Software Project Management, Robert K. Wysocki, Wiley, 2006.
5. Project Management in IT, Kathy Schwalbe, Cengage



L	T	P	Cr.
3	0	0	3

M.Tech. (II Sem.)

25DS18- BIG DATA ANALYTICS

**COURSE OBJECTIVES:**

1. Optimize business decisions and create competitive advantage with Big Data analytics
2. Introducing Java concepts required for developing map reduce programs
3. Derive business benefit from unstructured data
4. Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
5. To introduce programming tools PIG & HIVE in Hadoop ecosystem.

**Course Outcomes:**

		Knowledge Level (L)#
<b>CO1</b>	<b>Preparing</b> for data summarization, query, and analysis.	L2
<b>CO2</b>	<b>Applying</b> data modelling techniques to large data sets	L3
<b>CO3</b>	<b>Creating</b> applications for Big Data analytics.	L2
<b>CO4</b>	<b>Demonstrate and Develop</b> the pig and Latin Scripts	L4

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	2	2	2	3	
<b>CO2</b>	3	3	2	2	3	
<b>CO3</b>	2	3	3	2	3	
<b>CO4</b>	3	2	2	2	3	

**UNIT-I****Data structures in Java:** Linked List, Stacks, Queues, Sets, Maps;

Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization

**UNIT-II****Working with Big Data:** Google File System, Hadoop Distributed File System (HDFS) Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, Job Tracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.**UNIT-III****Writing Map Reduce Programs:** A Weather Dataset, Understanding Hadoop API for Map Reduce Framework (Old and New), Basic programs of Hadoop Map Reduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Practitioner**UNIT-IV****StreamMemory and Spark:** Introduction to Streams Concepts– Stream Data Model and Architecture, Stream computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Introduction to Spark Concept, Spark Architecture and components, Spark installation, Spark RDD (Resilient Distributed Dataset) – Spark RDD operations**UNIT-V**

Hadoop Programming Made Easier Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

**TEXT BOOKS:**

1. Wiley & Big Java 4th Edition, Cay Horstmann, Wiley John Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3<sup>rd</sup> Edition, O'reilly

**REFERENCE BOOKS:**

1. Hadoop in Action by Chuck Lam, MANNING Publ.
2. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnik, Bruce Brown, Rafael Coss
3. Hadoop in Practice by Alex Holmes, MANNING Publ.
4. Big Data Analytics by Dr. A.Krishna Mohan and Dr.E.Laxmi Lydia
5. Hadoop Map Reduce Cookbook, SrinathPerera, ThilinaGunarathne

**Software Links:**

1. Hadoop: <http://hadoop.apache.org/>
  2. Hive: <https://cwiki.apache.org/confluence/display/Hive/Home>
- Piglatin: <http://pig.apache.org/docs/r0.7.0/tutorial.html>

M.Tech. (II Sem.)

**25DS19- OBJECT ORIENTED ANALYSIS & DESIGN**

L	T	P	Cr.
3	0	0	3

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Describe the structure and inherent complexity of software systems and explain the design of complex systems.	L2
<b>CO2</b>	Apply UML principles and structural modeling techniques to real-world systems using diagrams.	L3
<b>CO3</b>	Construct and interpret class, object, and advanced structural diagrams for software systems.	L3
<b>CO4</b>	Model system behaviors using use cases, interaction, and activity diagrams	L3
<b>CO5</b>	Analyze and develop advanced behavioral and architectural UML diagrams including state, component, and deployment diagrams.	L4

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	3	2	2	1		
<b>CO2</b>	3	3	3	2	3	
<b>CO3</b>	3	3	3	2	3	1
<b>CO4</b>	2	3	3	2	3	
<b>CO5</b>	2	3	3	3	3	

**UNIT-I**

**Introduction:** The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, Designing Complex Systems. **Case Study:** System Architecture: Satellite-Based Navigation

**UNIT-II**

**Introduction to UML:** Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle. **Basic Structural Modeling:** Classes, Relationships, common Mechanisms, and diagrams. **Case Study:** Control System: Traffic Management.

**UNIT-III**

**Class & Object Diagrams:** Terms, concepts, modeling techniques for Class & Object Diagrams. **Advanced Structural Modeling:** Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. **Case Study:** AI: Cryptanalysis.

**UNIT-IV**

**Basic Behavioral Modeling-I:** Interactions, Interaction diagrams Use cases, Use case Diagrams, Activity Diagrams.

**Case Study:** Web Application: Vacation Tracking System.

**UNIT-V**

**Advanced Behavioral Modeling:** Events and signals, state machines, processes and Threads, time and space, state chart diagrams. **Architectural Modeling:** Component, Deployment, Component diagrams and Deployment diagrams

**Case Study:** Weather Forecasting

**Text Books:**

1. Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston , “Object- Oriented Analysis and Design with Applications”, 3rd edition,2013, PEARSON.
2. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide,Pearson Education.

**Reference Books:**

1. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education.
2. Pascal Roques: Modeling Software Systems Using UML2, WILEY- Dreamtech India Pvt. Ltd.
3. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.

L	T	P	Cr.
3	0	0	3

M.Tech. (II Sem.)

25DS20- QUANTUM COMPUTING

**Course Objectives:**

- To introduce the fundamentals of quantum computing, the problem-solving approach using finite dimensional mathematics

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
CO1	Explain the interdisciplinary foundations of quantum computing from mathematics, physics, and biology	L2
CO2	Apply the principles of quantum mechanics and linear algebra to analyze quantum states and measurements.	L3
CO3	Construct and interpret quantum circuits using single and multi-qubit gates, and represent states using Bloch sphere.	L3
CO4	Analyze and apply quantum algorithms such as Deutsch, Shor, and Grover to relevant computational problems.	L4
CO5	Evaluate quantum error correction methods, and compare classical vs quantum information and cryptography techniques.	L4

#Based on suggested Revised BTL

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	1	
CO2	2	1	3	3	2	
CO3	2	1	3	2	3	1
CO4	3	2	3	3	3	
CO5	3	2	3	2	2	2
CO6						

**UNIT-I**

**History of Quantum Computing:** Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations

**UNIT-II**

**Background Mathematics:** Basics of Linear Algebra, Hilbert space, Probabilities and measurements. **Background Physics:** Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. **Background Biology:** Basic concepts of Genomics and Proteomics (Central Dogma)

**UNIT-III**

**Qubit:** Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.

**UNIT-IV**

**Quantum Algorithms:** Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm

**UNIT-V**

**Noise and error correction:** Graph states and codes, Quantum error correction, fault-tolerant computation. **Quantum Information and Cryptography:** Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation

**Text Books:**

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge

**Reference Books:**

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.I: Basic Concepts, Vol II
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms

M.Tech. (II Sem.)

**25DS21- INFORMATION THEORY AND CODING**

L	T	P	Cr.
3	0	0	3

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Understand the mathematical foundation of information theory and various source coding techniques.	L2
<b>CO2</b>	Analyze and apply linear block codes and syndrome decoding techniques in data storage and transmission systems	L3
<b>CO3</b>	Apply cyclic codes for error detection and correction and evaluate their decoding methods.	L3
<b>CO4</b>	Design convolutional coding schemes and implement Viterbi and sequential decoding for error control.	L4
<b>CO5</b>	Explain and implement BCH codes and decoding procedures for single and double error correction	L3

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	3	1	2
<b>CO2</b>	2	2	3	3	2	2
<b>CO3</b>	2	2	3	3	2	2
<b>CO4</b>	3	2	3	3	3	3
<b>CO5</b>	3	2	3	3	2	3

**UNIT-I**

Coding for Reliable Digital Transmission and storage Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies. Source Codes: Shannon-fano coding, Huffman coding

**UNIT-II**

**Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error- Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

**UNIT-III**

**Cyclic Codes:** Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

**UNIT-IV**

**Convolutional Codes:** Encoding of Convolutional Codes- Structural and Distance Properties, state, tree, trellis diagrams, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system

**UNIT-V**

**BCH Codes:** Minimum distance and BCH bounds, Decoding procedure for BCH codes, Syndrome computation and iterative algorithms, Error locations polynomials for single and double error correction

**TEXT BOOKS:**

1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc 2014.
2. Error Correcting Coding Theory-Man Young Rhee, McGraw – Hill Publishing 1989

L	T	P	Cr.
3	0	0	3

M.Tech. (II Sem.)

25DS22- BLOCK CHAIN TECHNOLOGIES

**Course Objectives:**

- To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
- To understand public block chain system, Private block chain system and consortium block chain.
- Able to know the security issues of blockchain technology.

**Course Outcomes:** At the end of the course, student will be able to (Four to Six )

		Knowledge Level (L)#
<b>CO1</b>	Understand the fundamentals of blockchain technology, types of blockchains, consensus mechanisms, and cryptocurrencies.	L2
<b>CO2</b>	Analyze public blockchain systems and smart contracts with use cases in Ethereum and industry.	L4
<b>CO3</b>	Compare private and consortium blockchains and apply key concepts in platforms like Hyperledger and Corda.	L3
<b>CO4</b>	Examine security, privacy, performance, and compliance issues in blockchain networks.	L4
<b>CO5</b>	Develop and test blockchain applications using Python and Hyperledger Fabric through case studies	L3

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	2	1	3	2	2	2
<b>CO2</b>	2	2	3	2	2	2
<b>CO3</b>	2	2	3	2	3	2
<b>CO4</b>	3	2	3	2	2	3
<b>CO5</b>	3	2	3	2	3	3

**UNIT-I**

**Fundamentals of Blockchain:** Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage

**UNIT-II**

**Public Blockchain System:** Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain. Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

**UNIT-III**

**Private Blockchain System:** Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain. Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.



#### UNIT-IV

**Security in Blockchain:** Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

#### UNIT-V

##### **Blockchain Case Studies:**

Case Study 1 – Retail,

Case Study 2 – Banking and Financial Services,

Case Study 3 – Healthcare,

Case Study 4 – Energy and Utilities.

**Blockchain Platform using Python:** Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain. Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

##### **Text book:**

1. “Block chain Technology”, Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

##### **Reference Books:**

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley

L	T	P	Cr.
0	1	2	2

**M.Tech. (II Sem.)****25DS53- LARGE LANGUAGE MODELS LAB****Software Required: Python****List of Experiments**

1. Write a program to implement word Tokenizer, Sentence and Paragraph Tokenizers. Check how many words are there in any corpus. Also check how many distinct words are there?
2. Write a python program to eliminate stopwords using nltk
3. Write a python program to perform tokenization by word and sentence using nltk
4. Write a program to implement Perceptron
5. Write a Program to implement AND OR gates using Perceptron
6. Applying the Autoencoder algorithms for encoding the real-world data
7. Word Analysis
8. Word Generation
9. Building Chunker
10. Building POS Tagger
11. POS Tagging: Hidden Markov Model
12. POS Tagging: Viterbi Decoding
15. Demonstrate the use of Expectation Maximization based clustering algorithm

M.Tech. (II Sem.)

25DS54- MACHINE LEARNING LAB

L	T	P	Cr.
0	1	2	2

**Course Objectives:**

- To learn about computing central tendency measures and Data preprocessing techniques
- To learn about classification and regression algorithms
- To apply different clustering algorithms for a problem.

**Course Outcomes:** After the completion of this course, the students will be able to:

		Knowledge Level (L)#
<b>CO1</b>	Develop program for computing central tendency measures and Apply Data Preprocessing techniques	L3
<b>CO2</b>	Build Classifiers using KNN, Decision Tree, Random Forest algorithms	L3
<b>CO3</b>	Implement classification algorithms such as Naïve Bayes, SVM, Multi-Layer Perceptron	L3
<b>CO4</b>	Apply clustering algorithms such as K-Means, Fuzzy C-Means and Expectation Maximization for a problem	L3

**Software Required: Python/R/Weka**

## CONTENTS

1. Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation.
2. Apply the following Pre-processing techniques for a given dataset.
  - Attribute selection
  - Handling Missing Values
  - Discretization
  - Elimination of Outliers
3. Apply KNN algorithm for classification and regression
4. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results
5. Demonstrate decision tree algorithm for a regression problem
6. Apply Random Forest algorithm for classification and regression
7. Demonstrate Naïve Bayes Classification algorithm
8. Apply Support Vector algorithm for classification
9. Demonstrate simple linear regression algorithm for a regression problem
10. Apply Logistic regression algorithm for a classification problem
11. Demonstrate Multi-layer Perceptron algorithm for a classification problem
12. How to install and Load CSV files to Python Pandas

13. Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K

14. Demonstrate the use of Fuzzy C-Means Clustering.

15. Demonstrate the use of Expectation Maximization based clustering algorithm

III Semester	25RM01-RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

**Pre-requisites: Knowledge in Engineering, English**

**Course Objective:** To understand the research problem, to know the literature studies, plagiarism and ethics, to get the knowledge about technical writing, to analyse the nature of intellectual property rights and new developments and research related information and to know the patent rights.

**Course Outcomes:** After the completion of the course, students should be able to

- CO1 Analyze the research problem and its formulation.
- CO2 Analyze the significance of research ethics
- CO3 Apply the information technology for better tomorrow and to develop creativity.
- CO4 Identify the importance of intellectual property rights to be promoted among students in general & engineering in particular
- CO5 Understand the IPR protection for new and better products, and in turn brings about, economic growth and social benefits.

**UNIT I- RESEARCH PROBLEM AND SCOPE FOR SOLUTION**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**UNIT II- FORMAT**

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**UNIT III- PROCESS AND DEVELOPMENT**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

**UNIT IV- PATENT RIGHTS**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

**UNIT V- NEW DEVELOPMENTS IN IPR**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**TEXT BOOKS**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

**REFERENCES**

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008