M.Sc. Computer Science with Data Analytics

Syllabus

AFFILIATED COLLEGES

Program Code: ***

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A" Grade by NAAC, Ranked 13th among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

M.Sc. Computer Science With Data Analytics

SYLLABUS

Program Educational Objectives (PEOs)	
The **MSc CS with DA** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	To enrich the students with the clear picture of the course objectives and to map their requirements.
PEO2	To enable the students, to understand the core concepts, visualize and to apply them in the real time scenarios.
PEO3	To impart the need for consistent learning, importance of research & development for the welfare of the society and to the nation at large.

Program Specific Outcomes (PSOs)	
After the successful completion of **M.Sc. CS With DA** program, the students are expected to	
PSO1	Able to analyze, design and develop problem solving skills in the discipline of computer science.
PSO2	Acquire evaluation of potential benefits of alternative solution in designing software and/or hardware systems in broad range of open source programming languages to withstand technological changes.
PSO3	Able to pursue careers in IT industry/ consultancy/ research and development, teaching and allied areas related to computer science.
PSO4	Adapt to the continuous technological change in computational science and update themselves to meet the industry requirements and standards.
PSO5	Apply the practices and strategies of computer science for software project development to deliver a quality software product and contribute to research in the chosen field and perform effectively.

Program Outcomes (POs)	
On successful completion of the **M.Sc. CS With DA** program	
PO1	Develop creativity and problem solving skills with the knowledge of computing and mathematics.
PO2	Ability to develop and carry out experiments, interpret and infer data.
PO3	Design algorithms and develop software to aid solutions to industry and governments.
PO4	Review the latest technology and tool handling mechanism.
PO5	Analyze the outcome to solve global environment related issues.
PO6	Apply the knowledge in lifelong learning journey to equip themselves.
PO7	Identify the perspective of business practices, risks and limitations.
PO8	Work with professional and ethical values.
PO9	Formulate the responsibilities of human rights and entrepreneurial spirit.
PO10	Understand the methods to communicate effectively and work collectively.

SUGUNA COLLEGE OF ARTS AND SCIENCE, COIMBATORE

M. Sc. Computer Science with Data Analytics

SCHEME OF EXAMINATIONS – CBCS PATTERN

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
13A	Paper I : Analysis & Design of Algorithms	4	4		25	75	100
13B	Paper II : Advanced Software Engineering	4	4		25	75	100
13C	Paper III : Python Programming	4	4		25	75	100
13D	Paper IV : Principles of Data Science	4	4		25	75	100
13E	Paper V:Probability & Statistics	4	4		25	75	100
13P	Practical I : Algorithm Lab	4		5	40	60	100
13Q	Practical II : Python Programming Lab	4		5	40	60	100
	Total	24	20	10			
SECOND SEMESTER							
23A	Paper V : Cloud Computing	4	4		25	75	100
23B	Paper VI Data Mining and Analytics	4	4		25	75	100
23C	Paper VII :Data Visualization	4	4		25	75	100
23D	Paper VIII : Artificial Intelligence & Machine Learning	4	4		25	75	100
2EA/2EB /2EC/2E D	**Elective – I**	4	4		25	75	100
23P	Practical III: Data Mining Lab using R	4		5	40	60	100
23Q	Practical IV: Data Visualization Lab	4		5	40	60	100
	Total	28	20	10			

THIRD SEMESTER							
33A	Paper IX : Digital Image Processing	4	4		25	75	100
33B	Paper X: Business Analytics	4	4		25	75	100
33C	Paper XI: Network Security and Cryptography	4	4		25	75	100
33D	Paper XII : Big Data Analytics Framework & Tool	4	4		25	75	100
3EA / 3EB / 3EC / 3ED	**Elective – II**	4	4		25	75	100
33P	Practical V: Big Data Analytics Lab	4		4	40	60	100
33Q	Practical VI : Machine Learning Lab	4		4	40	60	100
33R	Practical VII : Mini Project And Viva-voce	2		2	25	25	50
	Total	30	20	10			
FOURTH SEMESTER							
47V	Project work and Viva-voce	8			50	150*	200
	Total	8					200
	Grand Total	90					2250
ONLINE COURSES							
1.	**#SWAYAM / MOOC**	2					
2.	**#Job oriented Certificate course**	2					

***** Project Evaluation – 100 marks & Viva Voice – 50 marks in ESE

During IV Semester

ELECTIVE – I

1.1 Social Media Analytics

1.2 Design Thinking and Problem Solving

1.3 Text Analytics

1.4 Digital Marketing Analytics

ELECTIVE – II

2.1. Health Care Data Analytics

2.2. Block Chain Technology

2.3. Deep Learning

2.4. Robotic Process Automation for Business

FIRST SEMESTER

Course code		ANALYSIS & DESIGN OF ALGORITHMS	L	T	P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Basic Algorithms	Syllabus Version		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the Elementary Data Structures and algorithms.
2. Presents an introduction to the algorithms, their analysis and design
3. Discuss various methods like Basic Traversal And SearchTechniques, divide and conquer method, Dynamic programming, backtracking
4. Understood the various design and analysis of the algorithms.

Expected Course Outcomes:

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

1	Get knowledge about algorithms and determines their time complexity. Demonstrate specific search and sort algorithms using divide and conquer technique.	K1,K2
2	Gain good understanding of Greedy method and its algorithm.	K2,K3
3	Able to describe about graphs using dynamic programming technique.	K3,K4
4	Demonstrate the concept of backtracking & branch and bound technique.	K5,K6
5	Explore the traversal and searching technique and apply it for trees and graphs.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	15 hours

Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity-Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heapsort- Graph.

Unit:2	TRAVERSAL AND SEARCH TECHNIQUES	15 hours

Basic Traversal And Search Techniques: Techniques for Binary Trees-Techniques for Graphs - Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.

Unit:3	GREEDY METHOD	15 hours

The Greedy Method: - General Method – Knapsack Problem – Minimum Cost Spanning Tree – Single Source Shortest Path.

Unit:4	DYNAMIC PROGRAMMING	15 hours

Dynamic Programming - General Method – Multistage Graphs – All Pair Shortest Path – Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.

Unit:5	BACKTRACKING	13 hours
Backtracking: - General Method – 8-Queens Problem – Sum Of Subsets – Graph Coloring – Hamiltonian Cycles – Branch And Bound: - The Method – Traveling Salesperson.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Ellis Horowitz,"Computer Algorithms", Galgotia Publications.
2	Alfred V.Aho,John E.Hopcroft,Jeffrey D.Ullman, "Data Structures and Algorithms".
Reference Books	
1	Goodrich, "Data Structures & Algorithms in Java", Wiley 3rd edition.
2	Skiena,"The Algorithm Design Manual",SecondEdition,Springer , 2008
3	AnanyLevith,"Introduction to the Design and Analysis of algorithm", Pearson Education Asia, 2003.
4	Robert Sedgewick,Phillipe Flajolet,"An Introduction to the Analysis of Algorithms", Addison-Wesley Publishing Company,1996.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
3	https://www.javatpoint.com/daa-tutorial
Course Designed By:	

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	S	L	M	L	S	M
CO2	S	S	S	S	S	M	S	M	S	M
CO3	S	S	S	S	S	M	S	M	S	M
CO4	S	S	S	S	S	M	S	M	S	M
CO5	S	S	S	S	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code		ADVANCED SOFTWARE ENGINEERING	L	T	P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Basics of Software Engineering & SPM	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Introduce to Software Engineering, Design, Testing and Maintenance.
2. Enable the students to learn the concepts of Software Engineering.
3. Learn about Software Project Management, Software Design & Testing.

Expected Course Outcomes:

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

1	Understand about Software Engineering process	K1,K2
2	Understand about Software project management skills, design and quality management	K2,K3
3	Analyze on Software Requirements and Specification	K3,K4
4	Analyze on Software Testing, Maintenance and Software Re-Engineering	K4,K5
5	Design and conduct various types and levels of software quality for a software project	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	15 hours

Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.

Unit:2	SOFTWARE REQUIREMENTS	15 hours

Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Result management system. Software Quality Management – Software Quality, Software Quality Management System, ISO 9000, SEI CMM.

Unit:3	PROJECT MANAGEMENT	15 hours

Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead‟s software science – Staffing level estimation – Scheduling – Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.

Unit:4	SOFTWARE DESIGN	15 hours

Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.		
Unit:5	**SOFTWARE TESTING**	**13 hours**
Software Testing: A Strategic approach to software testing – Terminologies – Functional testing – Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging – Testing tools - Metrics-Reliability Estimation. Software Maintenance - Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Books

1	An Integrated Approach to Software Engineering – Pankaj Jalote, Narosa Publishing House, Delhi, 3rd Edition.
2	Fundamentals of Software Engineering – Rajib Mall, PHI Publication, 3rd Edition.

Reference Books

1	Software Engineering – K.K. Aggarwal and Yogesh Singh, New Age International Publishers, 3 rd edition.
2	A Practitioners Approach- Software Engineering, - R. S. Pressman, McGraw Hill.
3	Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Manodrioli,PHIPublication.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.javatpoint.com/software-engineering-tutorial
2	https://onlinecourses.swayam2.ac.in/cec20_cs07/preview
3	https://onlinecourses.nptel.ac.in/noc19_cs69/preview

Course Designed By:

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		PYTHON PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Basics of any OO Programming Language	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Presents an introduction to Python, creation of web applications, network applications and working in the clouds
2. Use functions for structuring Python programs
3. Understand different Data Structures of Python
4. Represent compound data using Python lists, tuples and dictionaries

Expected Course Outcomes:

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

1	Understand the basic concepts of Python Programming	K1,K2
2	Understand File operations, Classes and Objects	K2,K3
3	Acquire Object Oriented Skills in Python	K3,K4
4	Develop web applications using Python	K5
5	Develop Client Server Networking applications	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	15 hours

Python: Introduction – Numbers – Strings – Variables – Lists – Tuples – Dictionaries – Sets– Comparison.

Unit:2	CODE STRUCTURES	15 hours

Code Structures: if, elseif, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions.

Unit:3	MODULES, PACKAGES AND CLASSES	15 hours

Modules, Packages, and Programs: Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. **Objects and Classes:** Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent with super – In self Defense – Get and Set Attribute Values with Properties – Name Mangling for Privacy – Method Types – Duck Typing – Special Methods –Composition.

Unit:4	DATA TYPES AND WEB	13 hours

Data Types: Text Strings – Binary Data. **Storing and Retrieving Data:** File Input/Output – Structured Text Files – Structured Binary Files - Relational Databases – NoSQL Data Stores.

Web: Web Clients – Web Servers – Web Services and Automation

Unit:5	SYSTEMS AND NETWORKS	15 hours
Systems: Files –Directories – Programs and Processes – Calendars and Clocks. **Concurrency:** Queues – Processes – Threads – Green Threads and gevent – twisted – Redis. **Networks:** Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – ZeroMQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and MapReduce – Working in the Clouds.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Bill Lubanovic, "Introducing Python", O'Reilly, First Edition-Second Release, 2014.
2	Mark Lutz, "Learning Python", O'Reilly, Fifth Edition, 2013.
Reference Books	
1	David M. Beazley,"Python Essential Reference", Developer's Library, Fourth Edition,2009.
2	SheetalTaneja,Naveen Kumar, "Python Programming-A Modular Approach",PearsonPublications.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
Course Designed By:	

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	M
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	S	M
CO5	S	S	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

		PRINCIPLES OF DATA SCIENCE		L	T	P	C
Core/Elective/Supportive		Core		**4**			**4**
Pre-requisite		**Nil**	**Syllabus Version**		**2025-2026**		

Course Objectives:

The main objectives of this course are to:

1 To understand Data source evolution, data Characteristics and data processing models.
2 To understand and apply data processing architecture ,Eco System Components of Big Data Frameworks HADOOP, SPARK Map Reduce

To analyze and Build Data Science use cases for specific domain and applications.

Expected Course Outcomes:

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

1	Understand Data sources, generations, data formats, Data Evolution, Data from various domains	K1, K2
2	Understand Big Data Characteristics What, Why, When, Limitation of traditional approaches and models. Map Big Vs to Data Domains	K3
3	Understand Big Data	K2
4	Understand the Role of Big Data and Artificial Intelligence – Ethics – AI Applications	K2-K5
5	Analyze various domains of Big Data Characteristics, Platform, Programming Model and Design Big Data framework ecosystem, and data processing framework of domains of Marketing, Health Care and Supply Chain	K4-K5 K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Introduction to Data Evolution & Sources**	**12-- hours**

Data Evolution: Data Development Time Line – ICT Advancement-a Perspective – Data Growth-a Perspective – IT Components-Business Process – Landscape-Data to Data Science – Understanding data: Introduction – Type of Data: Numeric – Categorical – Graphical – High Dimensional Data — Data Classification –-Data Formats: Structured, Semi-Structured and Un-Structured – Data Sources: Time Series – Transactional Data – Biological Data – Spatial Data – Social Network.

Unit:2	**Data Science**	**12-- hours**

Data Science: Data Science - A Discipline – Data Science vs Statistics, Data Science vs Mathematics, Data Science vs Programming Language, Data Science vs Database, Data Science vs Machine Learning. Data Analytics- Relation: Data Science, Analytics and Big Data Analytics. Data Science Components – Big data technology – Data Science user- roles and skills.

Unit:3	**Big Data Towards Data Science**	**12-- hours**

Big Data: Introduction To Big Data: - Evolution – Data as Economy - What is Big Data – Sources of Big Data. – Big Data Myths - Characteristics of Big Data 6Vs – Big Data Use cases - Big data-Challenges of Conventional Systems- -– Data Processing Models – Limitation of Conventional Data Processing Approaches - Data Discovery-Traditional Approach, Big Data Technology: Big Data Exploration - Data Augmentation – Operational Analysis – 360 View of Customers – Security and Intelligence.

Unit:4	**Big Data and AI : Roles and Skills**	**12-- hours**

AI: Cognitive Computing : Learning Perceptions – Terminologies - Machine Learning – Neural Networks – Deep Learning - NLP – Speech Processing – Big Data and AI – Ethics in AI Research - Advanced Applications – AI Myths – Data Science Roles Data Scientist , Data Architect, Data Analyst – Machine Learning Engineer - Skills

Unit:5	**Data Science Use cases**	**10-- hours**

Data Science & Big Data Use cases Specifications and Discussion – Data Sources Identification – Data Types –Data Classification – Data Characteristics of Big V's – Data Science P's – Big Data Frameworks – Data Analytics Classification – Applications of AI: Domains : Customer Insights – Behavioral Analysis –- Marketing – Retails – Insurance – Risk and Security –Health care – Supply Chain Logistics

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60-- hours**
Text Book(s)		
1	V. Bhuvaneswari, T. Devi, "**Big Data Analytics: A Practitioner's Approach**", Sci-Tech Publications, 2016.	
2	Han Hu, Yonggang Wen, Tat-Seng, Chua, XuelongLi,"**Toward Scalable Systems for Big**",	
3	Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, first edition. Reprint in 2016	
4	Joel Grus, **"Data Science from Scratch"**, 2nd Edition, O′Reilly Publisher, ISBN: 9781492041139, May 2019	
Reference Books : EBooks		
1	SinanOzdemir, Sunil Kakade, "**Principles of Data Science**", Second Edition, [Packt]	
2	David Natingga, **"Data Science for Algorithms in a Week",** Second Edition, [Packt]	
3	PrabhanjanTattar, Tony Ojeda, Et al, **"Practical Data Science Cookbook"**, Second Edition, [Packt], ISBN: 9781787129627	
4	Lillian Pierson, Jake Porway, **"Data Science for Dummies"**, Second Edition, John Wiley & Sons, Publishers, ISBN**:** 9781119327639, 2017	
5	Field Cady, **"The Data Science Handbook"**, John Wiley & Sons, Publishers, ISBN**:** 9781119092940, 2017	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	S	M	M	S	-	L	M	M	S
CO2	-	-	S	S	S	-	M	M	M	M
CO3	S	S	S	S	S	M	S	M	S	S
CO4	M	M	M	S	S	M	L	M	S	S
CO5	S	S	S	S	S	M	M	S	S	S

*S-Strong; M-Medium; L-Low

		PROBABILITY AND STATISTICS	L	T	P	C
Core/Elective/Supportive		**Core**	**4**			**4**
Pre-requisite		**Nil**	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

5. To understand the Probability Theory
6. To understand theoretical distributions and automata theory

Expected Course Outcomes:

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

1	To understand the concept of matrices	K2
2	To apply the principle of probability	K3
3	To apply and analyse the statistical measures for specific domain	K3
4	To analyse regression models and apply hypothesis testing specific domain	K4
5	To design and illustrate distribution models for specific domains	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Introduction to Set Theory**	**10-- hours**

Set Theory: Basic set operations, relations and functions, transitive closure relation, principle of mathematical induction. Matrices: Properties of determinants, inverse of a matrix, Eigen values and Cayley Hamilton theorem.

Unit:2	**Probability Theory**	**12-- hours**

Introduction to Probability Theory: Sample space and events, axioms of Probability, conditional probability, Bayes' theorem, independence of events.

Unit:3	**Descriptive Statistics**	**12 -- hours**

Frequency Distribution - Continuous or Grouped Frequency Distribution - Magnitude of Class intervals - Cumulative Frequency Distribution - Two Way Frequency Distribution - Measures of Central Tendency: Arithmetic Mean, Geometric Mean - Harmonic Mean - Median, Mode - Dispersion: Overview - Mean Deviation – Standard Deviation – Combined Standard Deviation

Unit:4	**Hypothesis Testing**	**12-- hours**

Correlation –Rank Correlation –Regression -Test of Hypothesis –Large Sample Test-Small Sample Test-t test –Chi Square Test –F-test – ANOVA-one way and two way

Unit:5	**Theoretical Distribution**	**12-- hours**

Theoretical Distribution: Binominal Distribution - Obtaining Coefficient - Poisson Distribution - Normal Distribution - Poisson - Cumulative Poisson Process and its generalization - applications in different business domain - ARMA and ARIMA - Monte Carlo Simulations

Unit:6	**Contemporary Issues**	**2 --hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**60-- hours**

Text Book(s)

1	William A. R. Weiss **"An Introduction to Set Theory"** Publisher: University of Toronto 2008
2	RafVandebril, Marc Van Barel, Nicola Mastronardi, **"Matrix Computations and Semiseparab Matrices: Eigenvalue and Singular Value Methods"**, JHU Press, 2009.
3	By Vijay K. Rohatgi, A.K. Md. EhsanesSaleh. **"An Introduction To Probability And Statistics"**, ISBN: 978-1-118-79964-2, 3rd Ed , 2015.
4	S.P Guptha **"Statistical Methods"**, Sultan Chand and Sons
5	R.S.N. Pillai, Bagavathi, "Statistics Theory and Practice, S.Chand& Company, 2013

Reference Books

1	Charles E. Roberts, Jr, **"Introduction to Mathematical Proofs A Transition to Advanced Mathematics"** Denny Gulick, 4th Edition, Published by Pearson, ISBN:9780134746753, 2018.
2	John R. Hauser, **"Numerical Methods for Nonlinear Engineering Models"**, Springer Netherlands, ISBN: 9401777071, 9789401777070, 1013 pages, 2017.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

	Course Title	Duration	Provider
1	Advanced Probability Theory	12 Weeks	Swayam
2	Discrete Mathematics	12 Weeks	Swayam
3	Numerical Methods And Simulation Techniques For Scientists and Engineers	8 weeks	Swayam
4	Theory of Automation	8 Weeks	Swayam

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	M	M	S	S	L	S
CO2	S	M	M	M	M	M	S	S	L	S
CO3	S	S	S	S	M	M	M	M	L	S
CO4	S	S	S	S	M	M	M	M	L	S
CO5	S	S	S	S	S	M	S	S	L	S

***S-Strong; M-Medium; L-Low**

Course code		PRACTICAL I : ALGORITHM LAB	L	T	P	C
Core/Elective/Supportive		Core			4	4
Pre-requisite		Basic Programming of C++ language	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. This course covers the basic data structures like Stack, Queue, Tree , List.
2. This course enables the students to learn the applications of the data structures using various techniques
3. It also enable the students to understand C++ language with respect to OOAD concepts
4. Application of OOPS concepts.

Expected Course Outcomes:

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

1	Understand the concepts of object oriented with respect to C++	K1,K2
2	Able to understand and implement OOPS concepts	K3,K4
3	Implementation of data structures like Stack, Queue, Tree , List using C++	K4,K5
4	Application of the data structures for Sorting, Searching using different techniques.	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF PROGRAMS	75 hours

1) Write a program to solve the tower of Hanoi using recursion.
2) Write a program to traverse through binary search tree using traversals.
3) Write a program to perform various operations on stack using linked list.
4) Write a program to perform various operation in circular queue.
5) Write a program to sort an array of an elements using quick sort.
6) Write a program to solve number of elements in ascending order using heap sort.
7) Write a program to solve the knapsack problem using greedy method
8) Write a program to search for an element in a tree using divide & conquer strategy.
9) Write a program to place the 8 queens on an 8X8 matrix so that no two queens Attack.

Course code		PRACTICAL II : PYTHON PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Core			4	4
Pre-requisite		Basics of any OO Programming Language	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. This course presents an overview of elementary data items, lists, dictionaries, sets and tuples
2. To understand and write simple Python programs
3. To Understand the OOPS concepts of Python
4. To develop web applications using Python

Expected Course Outcomes:

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

1	Able to write programs in Python using OOPS concepts	K1,K2
2	To understand the concepts of File operations and Modules in Python	K2,K3
3	Implementation of lists, dictionaries, sets and tuples as programs	K3,K4
4	To develop web applications using Python	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF PROGRAMS	75 hours

Implement the following in Python:

1. Programs using elementary data items, lists, dictionaries and tuples
2. Programs using conditional branches,
3. Programs using loops.
4. Programs using functions
5. Programs using exception handling
6. Programs using inheritance
7. Programs using polymorphism
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive web pages using forms.

Total Lecture hours	75 hours

Text Books

1	Bill Lubanovic, “Introducing Python”, O’Reilly, First Edition-Second Release, 2014.
2	Mark Lutz, “Learning Python”, O’Reilly, Fifth Edition, 2013.

Reference Books

1	David M. Beazley,"Python Essential Reference", Developer's Library, Fourth Edition,2009.
2	SheetalTaneja,Naveen Kumar, "Python Programming-A Modular Approach",PearsonPublications.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
Course Designed By:	

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

SECOND SEMESTER

Course code		CLOUD COMPUTING	L	T	P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Basics of Cloud & its Applications	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Gain knowledge on cloud computing, cloud services, architectures and applications.
2. Enable the students to learn the basics of cloud computing with real time usage
3. How to store and share, in and from cloud?

Expected Course Outcomes:

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

1	Understand the concepts of Cloud and its services	K1,K2
2	Collaborate Cloud for Event & Project Management	K3,K4
3	Analyze on cloud in – Word Processing, Spread Sheets, Mail, Calendar, Database	K4,K5
4	Analyze cloud in social networks	K5,K6
5	Explore cloud storage and sharing	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	12 hours

INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.

Unit:2	CLOUD COMPUTING	12 hours

CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloud computing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.

Unit:3	CLOUD SERVICES	12 hours

USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.

Unit:4	OUTSIDE THE CLOUD	12 hours

OUTSIDE THE CLOUD Evaluating web mail services, Evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating on line

groupware, collaborating via blogs and wikis.		
Unit:5	**STORING AND SHARING**	**10 hours**
STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Michael Miller, "Cloud Computing", Pearson Education, New Delhi, 2009.
Reference Books	
1	Anthony T. Velte, "Cloud Computing: A Practical Approach", 1st Edition, Tata McGraw Hill Education Private Limited, 2009.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial
Course Designed By:	

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	S	M	S	M	S	M	M	M	S
CO2	M	S	M	S	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course Code		**DATA MINING AND ANALYTICS**	**L**	**T**	**P**	**C**

Core/Elective/Supportive	Core	4			
Pre-requisite	**Nil**	**Syllabus**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. To understand the concepts of Data Warehouse architecture and apply for various domains.
2. To understand Data Mining techniques Cluster, Classification and Association Rule Mining.
3. To understand the concepts of Web mining, Text mining and Spatial mining.

Expected Course Outcomes:

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

1	Understand Data warehousing architecture and process.	K2
2	Apply the mining techniques like association, classification and clustering on datasets	K3
3	Understand the visualization package R	K1.K2
4	Analyse the data set to understand the issues in the real world problem	K4,K5 K6
5	Apply the statistical measures in R	K3,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	**Data Warehousing**	**8 hours**

Data Warehouse -Introduction - Multidimensional data model - OLAP operations - Warehouse schema - Data warehousing architecture - Warehouse Schema - Warehouse server - Meta data - OLAP Engine - Data warehouse backend process - Data Warehouse Technology - Warehousing Software - Cloud data warehousing. Data Warehousing Case Study: Government, Tourism and Industry.

Unit:2	**Data Mining**	**12 hours**

Data Mining: Introduction – Data as a Subject - Definitions- KDD vs. Data mining- Data Mining techniques-Current Trends in Data Mining. Association Rules: Concepts- Methods to discover Association rules- A priori algorithm.

Clustering: Data Attribute Types – Data Similarity and Dissimilarity - Clustering paradigms– Partition algorithm-K-Means algorithm,

Classification: Introduction – Decision Trees: Tree Construction Principle – Attribute Selection measure – Tree Pruning - Decision Tree construction Algorithm – CART – ID3.

Unit:3	**Exploratory Data Analytics: Visualization Package R**	**14 hours**

Introduction - Overview and History of R - Data Types - R Objects and Attributes - Vectors – Removing Missing Values-Combining Variables - Vectorized Operations – Apply() family - **Cleaning Data**: – Exploring Raw Data - Visualising Distributions - Typical Values - Unusual Values-Missing Values: Zeros And Nas - Filling Missing Values – Data Manipulation using dplyr() package-**Visualization Packages** – Understanding Plots - Aesthetics - Lattice – Ggplot2 – Plotly - Univariate Visualization: Histogram – Box Plot- Bar Chart - Multivariate Visualizations: Scatter Plot- Heat Map-**Reports & Dashboards:** Rmarkdown Package - Dashboards: Flex Dashboard: Layout: Row-based layouts - Attributes on sections - Multiple pages - Story boards – Components: Value boxes – Gauges-Text annotations - Navigation bar – Shiny Web App: Introduction Shiny - Layout - Control widgets-Reactive output - R scripts and Data - Reactive expressions – App Deployment.

Unit:4	**Data Insights**	**12 hours**

Data Insights: Data types – Categorical – Binary – ordinal – Nominal –Data Dimensions – Numerical Measures – Central Tendency – Mean – Median – Mode - Understanding data using central tendency – plotting histogram – density plots and inference of plot - Variability Measure – Variance - Range - IQC - and Standard Deviation – Sum of squares – Squared Deviations – Absolute Deviations - Identify outlier using Inter Quartile Range – Visualization using boxplot		
Unit:5	**Data Distribution**	**12 hours**
Data Distribution: Data standardizing – Z Score – Negative Z Score - Normalized Distribution– Probability Distributions - Probability of mean – location of mean distribution - Sampling Distributions — Standard Error - Standard Deviation of sampling distribution – Ratio of Sampling Distribution - Regression Analysis – Logistic Regression – Multiple Regression - ANNOVA Model – Parametric test - Non-Parametric Test		
Unit:6	**Contemporary Issues**	**2 hours**
Write an assignment on any one of the following: Analyze Global Datasets to understand Issues on Climate Change, Epidemic and Pandemic Outburst		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Jiawei Han, MichelineKamber, "**Data Mining Concepts and Techniques**", Morgan Kaufmann Publishers, 2012
2	Pieter Adriaans, DolfZantinge, "**Data Mining**", Addison Wesley, 2008.
3	Krzyszlof J Cios, WitoldPedrycz, "**Data Mining: A Knowledge Discovery Approach**", Springer, 2010.
4	V. Bhuvaneswari, "**Data Analytics with R – Step by Step"**, SciTech Publications, 2016.
5	Roger D. Peng, "**R Programming for Data Science**" Lean Publishing, 2014
6	Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters,"**A Beginner's Guide to R**" Springer, 2009
7	Hadley Wickham, **"R for Data Science: Import, Tidy, Transform, Visualize, and Model Data",**First Edition, O'Reilly Media Publisher, ISBN: 9781491910399, 2017

Reference Books

1	Arun K Pujari, "**Data Mining Techniques**", Universities Press. 2012
2	ArijayChaudhry, Dr. P .S Deshpande, "**Multidimensional Data Analysis and Data Mining**", Dreamtech press, 2009.
3	Brett Lantz, **"Machine Learning with R", Third Edition,** ISBN: 9781788295864, 2019, [Packt]
4	Kaelen Medeiros, "**R Programming Fundamentals**", ISBN: 9781789612998, 2018, [Packt]
5	VitorBinanchiLanzetta, "**Hands-On Data Science with R**", ISBN: 9781789139402, 2018, [Packt]
6	Omar Trejo Navarro, "**R Programming by Example**", ISBN: 9781788292542, 2017, [Packt]
7	**Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Second Edition, Pearson Education Publisher, ISBN: 9789386873521, 2018**
8	VigneshPrajapati, **"Big Data Analytics with R and Hadoop",** First Edition, PACKT Publishing Limited , ISBN: 9781782163282, 2013
9	Nina Zumel, **"Practical Data Science with R",**Dreamtech Press Publisher, ISBN: 9789351194378, 2014

10	Hadley Wickham, "**Advanced R"**, Second Edition, CRC Publisher

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1.	Data Visualization	4 Weeks
2.	Text Retrieval and Search Engines	6 Weeks
3.	Text Mining and Analysis	6 Weeks
4.	Pattern Discovery in Data Mining	4 Weeks
5.	Cluster Analysis in Data Mining	4 Weeks
6.	Data Mining Project	6 Weeks
7.	R Programming	4 Weeks
8.	Data Analysis with R	8 Weeks
9.	Introduction to Data Analytics	9 Weeks
10.	Introduction to R Software	9 Weeks

Web Link

1. http://www.celta.paris-sorbonne.fr/anasem/papers/miscelanea/InteractiveDataMining.pdf
2. https://www.javatpoint.com/data-mining-world-wide-web
3. https://www.peterindia.net/DataMiningLinks.html
4. https://www.datacamp.com/tracks/r-programming
5. https://www.tutorialspoint.com/r/index.htm
6. https://www.datamentor.io/r-programming/

Course Designed By:

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	-	M	-	M	-	M
CO2	S	S	S	S	-	S	S	M	-	M
CO3	S	S	S	S	S	M	S	L	-	L
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	M	M	S	M	-	S

*S-Strong; M-Medium; L-Low

Course Code		DATA VISUALIZATION	L	T	P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Nil	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. To understand how accurately represent voluminous complex data set in web and from other data sources.
2. To understand the methodologies used to visualize large data sets
3. To know how to work with visualization tools.

Expected Course Outcomes:

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

1	Understand the concepts of visualization	K2
2	Understand the methods for visualizing data in D3j, c3j, and Tableau	K1, K2
3	Apply Visualization methods for different data domains	K4
4	Design Interactive Charts based on Data	K3
5	Distinguish and Suggest the appropriate data visualization tools for domain specific applications and Design an Interactive data visualization story board for data	K4, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction to Data Visualization	12 hours

Definition – Methodology – Seven Stages of Data Visualization - Data Visualization Tools. Visualizing Data: Mapping Data onto Aesthetics – Visualizing Amounts - Visualizing Distributions: Histograms and Density Plots – Visualizing Propositions: – Visualizing Associations: Among Two or More Quantitative Variables – Visualizing Time Series and Other Functions of an Independent Variable – Trends – Visualizing Geospatial Data.

Unit:2	Interactive Data Visualization	12 hours

Introduction to D3 - Fundamental Technology: The Web – HTML – DOM – CSS – JavaScript – SVG. D3 Setup – Generating Page Elements – Binding Data - Drawing with data – Scales: Domains and Ranges – Normalization – Creating a Scale – Scaling the Scatter Plot – Other Methods and Other Scales. Axes – Modernizing the Chart – Update the Data – Transition – Updates – Interactivity.

Unit:3	D3 Based Reusable Chart Library	12 hours

Setup and Deployment – Generate Chart – Customize Chart: Additional Axis – Show Axis Label – Change Chart Type – Format Values – Size – Color – Padding –Tooltip. Use APIs: Load and Unload 1.Show and Hide – Focus – Transform – Groups – Grid – Regions – Flow – Revert – Toggle –Legend 2.Sub chart – Zoom – Resize. Customize Style. Building Real time and Live Updating animated graphs with C3.

Unit:4	Data Visualization Tools : Tableau	12 hours

Environment Setup – Navigation – File & Data Types. TA SOURCE: Custom Data View – Extracting Data – Fields Operations – Editing Meta Data – Data Joining – Data Blending. Worksheets.- Bar Chart – Line Chart – Pie Chart – Scatter Plot – Bubble Chart –Gantt Chart – Histograms - Waterfall Charts. Dashboard – Formatting – Forecasting – Trend Lines – Creating Dashboard

Unit:5	Power BI	10 hours

Power BI Features – Data Slicers – Data Transformation- Field Load – Formatting Currecy – transforming Columns – Mapping map with GIS – Filtering – Visualizing – Creating Dashboard (Specific Usecase or Dataset) – Publishing to Web		
Unit:6	**Contemporary Issues**	**2 hours**
Apply Visualization methods for different domains. Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Ben Fry, **"Visualizing Data: Exploring and Explaining Data with the Processing Environment"**, O'Reilly, 1st Edition, 2008.
2	Scott Murray, **"Interactive data visualization for the web: An Introduction to Designing with D3"**, O'Reilly, 2nd Edition, 2017.
3	Joshua N. Milligan, "**Learning Tableau 2019: Tools for Business Intelligence, data prep, and visual analytics",** Packt Publishing Limited, 2019.
4	Claus O. Wilke, **"Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures"**, O.Reilly, 2019.
5	Dan Clark, Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics , 22 February 2020

Reference Books :EBooks

1	Ritchie S. King, **"Visual Storytelling with D3: An Introduction to Data Visualization in JavaScript"**, Addison-wesley Data and Analytics, 2014.
2	Elijah Meeks, **"D3.js in Action: Data visualization with JavaScript"**, Second Edition, Manning Publications, 2017.
3	Lindy Ryan, **"Visual Data Storytelling with Tableau"**, 1st Edition, Pearson, 2018.

	Course Title	Duration	Provider
1.	Fundamentals of Visualization with Tableau	4 Weeks	Coursera

Web link

1. https://c3js.org/gettingstarted.html
2. https://www.tutorialspoint.com/tableau/index.htm
3. https://www.dashingd3js.com/table-of-contents
4. https://www.udacity.com-Data Visualization and D3.J
5. https://data-flair.training/blogs/power-bi-tutorial/

Course Designed by:

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	L	S	S	M	S
CO3	S	M	M	M	S	L	S	S	M	S
CO3	S	S	M	S	S	M	S	S	M	S
CO4	S	S	S	S	S	M	S	S	M	S
CO5	S	S	M	S	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

Course code		ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	L	T	P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Basics of AI & an Introduction about ML	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the basic functions of AI, Heuristic Search Techniques.
2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic.
3. Introduce Machine Learning with respect Data Mining, Big Data and Cloud.
4. Study about Applications & Impact of ML.

Expected Course Outcomes:

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

1	Demonstrate AI problems and techniques	K1,K2
2	Understand machine learning concepts	K2,K3
3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning	K3,K4
4	Analyze the impact of machine learning on applications	K4,K5
5	Analyze and design a real world problem for implementation and understand the dynamic behavior of a system	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	12 hours

Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.

Unit:2	SEARCH TECHNIQUES	12 hours

Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.

Unit:3	PREDICATE LOGIC	12 hours

Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge - Logic programming
- Forward Vs Backward reasoning - Matching - Control knowledge.

Unit:4	MACHINE LEARNING	12 hours

Understanding Machine Learning: What Is Machine Learning?-Defining Big Data-Big Data in Context with Machine Learning-The Importance of the Hybrid Cloud-Leveraging the Power of Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.		
Unit:5	**APPLICATIONS OF MACHINE LEARNING**	**10 hours**
Looking Inside Machine Learning:The Impact of Machine Learning on Applications - Data Preparation-The Machine Learning Cycle.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Elaine Rich and Kevin Knight," Artificial Intelligence", Tata McGraw Hill Publishers company Pvt Ltd, Second Edition, 1991.
2	George F Luger, "Artificial Intelligence",4th Edition, Pearson Education Publ,2002.
Reference Books	
1	Machine Learning For Dummies®, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.ibm.com/downloads/cas/GB8ZMQZ3
2	https://www.javatpoint.com/artificial-intelligence-tutorial
3	https://nptel.ac.in/courses/106/105/106105077/
Course Designed By:	

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		PRACTICAL III : DATA MINING USING R	L	T	P	C
Core/Elective/Supportive		Core			4	4
Pre-requisite		Basics of DM Algorithms & R Programming	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

7. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, regression….
8. To understand & write programs using the DM algorithms
9. To apply statistical interpretations for the solutions
10. Able to use visualizations techniques for interpretations

Expected Course Outcomes:

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

1	Able to write programs using R for Association rules, Clustering techniques	K1,K2
2	To implement data mining techniques like classification, prediction	K2,K3
3	Able to use different visualizations techniques using R	K4,K5
4	To apply different data mining algorithms to solve real world applications	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF PROGRAMS	75 hours

1.Programs using basic structures of R-Data Frames, Matrix,List.

2.Programs using Packages and Functions in R

3.Exercises to gather the insights and inference from a dataset.

4. Implement Apriori algorithm to extract association rule of datamining.
5. Implement k-means clustering technique.
6. Implement any one Hierarchal Clustering.
7. Implement Classification algorithm.
8. Implement Decision Tree.
9. Linear Regression.
10. Data Visualization.

Total Lecture hours	75 hours

Text Books

1	Margaret H. Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson education,2003.
2	C.S.R. Prabhu, “Data Warehousing Concepts,Techniques, Productsand Applications”, PHI, Second Edition

Reference Books

1	ArunK.Pujari, “Data Mining Techniques”, Universities Press (India) Pvt. Ltd.,2003.
2	Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining and OLAP”, TMCH, 2001.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html
Course Designed By:	

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		PRACTICAL IV : DATA VISUALIZATION LAB	L	T	P	C
Core/Elective/Supportive		Core	SCA	DA	ED: 5	.
Pre-requisite		Basic Programming language	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. To understand how accurately represent voluminous complex data set in web and from other data sources.
2. To understand the methodologies used to visualize large data sets
3. To know how to work with visualization tools.

Expected Course Outcomes:

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

1	Applying methods for visualizing data in D3j, c3j, and Tableau, Power BI	K3, k4
2	Apply Visualization methods for different data domains	K3,K4
3	Design Interactive Charts based on Data	K2,K3
4	Apply the appropriate data visualization tools for domain specific applications and Design an Interactive data visualization story board for data	K4, K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

LIST OF PROGRAMS	75 hours

1. Visualize prediction related analysis using visualization tool
2. Design a Sales forecast analysis dashboard
3. Analyze the dataset of marketing campaigns and visualize the performance
4. Analyze the product related information
5. Analyze the dataset of various crimes
6. Demonstrate 3D plotting
7. Demonstrate scatter plotting
8. Visualize business intelligence

Total Lecture hours	75 hours

Text Book(s)

1	Ben Fry, **"Visualizing Data: Exploring and Explaining Data with the Processing Environment"**, O'Reilly, 1st Edition, 2008.
2	Scott Murray, **"Interactive data visualization for the web: An Introduction to Designing with D3"**, O'Reilly, 2nd Edition, 2017.
3	Joshua N. Milligan, "**Learning Tableau 2019: Tools for Business Intelligence, data prep, and visual analytics",** Packt Publishing Limited, 2019.
4	Claus O. Wilke, **"Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures"**, O.Reilly, 2019.

Reference Books : EBooks

1	Ritchie S. King, **"Visual Storytelling with D3: An Introduction to Data Visualization in JavaScript"**, Addison-wesley Data and Analytics, 2014.
2	Elijah Meeks, **"D3.js in Action: Data visualization with JavaScript"**, Second Edition, Manning Publications, 2017.
3	Lindy Ryan, **"Visual Data Storytelling with Tableau"**, 1st Edition, Pearson, 2018.

	Course Title	Duration	Provider
1.	Fundamentals of Visualization with Tableau	4 Weeks	Coursera
Web link			

1. https://c3js.org/gettingstarted.html SCAA DATED: 18.05.2023 2. https://www.tutorialspoint.com/tableau/index.htm 3. https://www.dashingd3js.com/table-of-contents 4. https://www.udacity.com-Data Visualization and D3.J
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	S	L	S	S	-	S
CO2	S	S	M	S	S	M	S	S	-	S
CO3	S	S	S	S	S	M	S	S	-	S
CO4	S	S	M	S	S	M	S	S	-	S

*S-Strong; M-Medium; L-Low

3	https://nptel.ac.in/courses/106/106/106106179/
Course Designed By:	

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

THIRD SEMESTER

Course code		DIGITAL IMAGE PROCESSING	L	T	202P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Basics of Image Processing	Syllabus	2025-26		

Course Objectives:

The main objectives of this course are to:

1. Learn basic image processing techniques for solving real problems.
2. Gain knowledge in image transformation and Image enhancement techniques.
3. Learn Image compression and Segmentation procedures.

Expected Course Outcomes:

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

1	Understand the fundamentals of Digital Image Processing	K1,K2
2	Understand the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement	K2,K3
3	Apply, Design and Implement and get solutions for digital image processing problems	K3,K4
4	Apply the concepts of filtering and segmentation for digital image retrieval	K4,K5
5	Explore the concepts of Multi-resolution process and recognize the objects in an efficient manner	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	12 hours

Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.

Unit:2	IMAGE ENHANCEMENT	12 hours

Image Enhancement in the spatial domain:- Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods.

Unit:3	IMAGE RESTORATION	12 hours

Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.

Unit:4	IMAGE COMPRESSION	11 hours
Image Compression: Fundamentals – Image compression models – Elements of Information Theory – Error Free compression – Lossy compression – Image compression standards.		
Unit:5	**IMAGE SEGMENTATION**	**11 hours**
Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Second Edition, PHI/Pearson Education.
2	B. Chanda, D. Dutta Majumder, “Digital Image Processing and Analysis”, PHI, 2003.
Reference Books	
1	Nick Efford, “Digital Image Processing a practical introducing using Java”, Pearson Education, 2004.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial
Course Designed By:	

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	M	S	M	M	S
CO2	S	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

		BUSINESS ANALYTICS	L	T	P	C
Core/Elective/Supportive		**Core**	**4**			**4**
Pre-requisite		**Foundations of Data Science**	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. To understand the Probability Theory
2. To understand theoretical distributions and automata theory

Expected Course Outcomes:

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

1	Compare various domain areas and their challenges	K2
2	Apply the concepts of analytics to make better decisions	K3
3	Examine use cases for different domains.	K4
4	Evaluate the challenges faced in various domains and choose appropriate analytics solutions in all domains	K5
5	Propose suitable analytics solutions as required by the use cases.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Introduction**	**12-- hours**

Healthcare analytics – Introduction - Potential contributions - Challenges of healthcare industry - current and future state of healthcare analytics – top healthcare analytics adaptations

Unit:2	**Banking and Finance**	**12-- hours**

Banking and Finance: Systems of Banking – Commercial Banking – New Financial Services:Overview of Analytics in Insurance: Key Insurance Analytics – Challenges – Health Insurance Analytics, Life Insurance Analytics- Types of Insurance – Housing Finance.

Unit:3	**Telecommunication**	**10 -- hours**

Telecommunication: Introduction - End-User Needs and Demands- Telecom Business

Unit:4	**Retail analytics**	**12-- hours**

Retail analytics – Understanding the new consumer – Marketing in a consumer- driven era -Managing the brand to drive loyalty

Unit:5	**Case studies**	**12-- hours**

Case studies: Walmart, Netflix, Facebook, Uber, Amazon, Kaggle

Unit:6	**Contemporary Issues**	**2 --hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**60-- hours**

Reference Books	
1	Dwight McNeill(2013). A Framework for Applying Analytics in Healthcare: What Can Be Learned from Best Practices in Banking , Retail, Politics and Sports, Pearson Education
2	Gomez Clifford(2011). Banking and Finance Theory Law and practice, PHI Learning
3	Patricia L.Saporito(2014). Applied Insurance Analytics: A Framework for Driving More Value from Data Assets, Technologies and Tools, Pearson Education LTD
4	Anders Olsson(2005). Understanding Changing Telecommunications, Wiley Publications
5	Jennifer LeClaire, Danielle Dahlstrom, Vivian Braun. Business analytics in Retail for dummies, 2nd IBM Limited edition.
6	Purba Halady Rao (2013). Business Analytics. An application Focus, PHI Learning private ltd.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	L	-	-	-	-	-	M
CO2	S	M	S	S	M	-	S	L	-	M
CO3	S	S	S	L	-	L	M	L	-	L
CO4	M	M	S	S	-	-	S	-	-	L
CO5	S	S	S	M	-	L	M	L	-	L

***S-Strong; M-Medium; L-Low**

Course code		NETWORK SECURITY AND CRYPTOGRAPHY	L	T	P	C
Core/Elective/Supportive		Core	4			2025-26
Pre-requisite		Basics of Networks & its Security	Syllabus			

Course Objectives:

The main objectives of this course are to:

1. Enable students to learn the Introduction to Cryptography, Web Security and Case studies in Cryptography.
2. To gain knowledge on classical encryption techniques and concepts of modular arithmetic and number theory.
3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
4. To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.

Expected Course Outcomes:

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

1	Understand the process of the cryptographic algorithms	K1,K2
2	Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication	K2,K3
3	Apply and analyze appropriate security techniques to solve network security problem	K3,K4
4	Exploresuitable cryptographic algorithms	K4,K5
5	Analyze different digital signature algorithms to achieve authentication and design secure applications	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	12 hours

Introduction to Cryptography – Security Attacks – Security Services –Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.

Unit:2	CRYPTO SYSTEM	12 hours

Public-key Cryptosystem: Introduction to Number Theory - RSA Algorithm – Key Management - Diffie-Hell man Key exchange – Elliptic Curve Cryptography Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.

Unit:3	NETWORK SECURITY	12 hours

Network Security Practice: Authentication Applications – Kerberos – X.509 Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.

Unit:4	WEB SECURITY	10 hours
Web Security - Secure Socket Layer – Secure Electronic Transaction. System Security - Intruders and Viruses – Firewalls– Password Security.		
Unit:5	**CASE STUDY**	**12 hours**
Case Study: Implementation of Cryptographic Algorithms – RSA – DSA – ECC (C / JAVA Programming). Network Forensic – Security Audit - Other Security Mechanism: Introduction to: Stenography – Quantum Cryptography – Water Marking - DNA Cryptography		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books

1	William Stallings, "Cryptography and Network Security", PHI/PearsonEducation.
2	Bruce Schneir, "Applied Cryptography", CRC Press.

Reference Books

1	A.Menezes, P Van Oorschot and S.Vanstone, "Hand Book ofApplied Cryptography", CRC Press, 1997
2	AnkitFadia,"Network Security",MacMillan.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105031/
2	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3	https://www.tutorialspoint.com/cryptography/index.htm

Course Designed By:

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	S	M	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

		BIG DATA FRAMEWORKS AND TOOLS	L	T	P	C
Core/Elective/Supportive		Core	**4**			**4**
Pre-requisite		**Basics of Programming**	**Syllabus Version**		**2025-2026**	

Course Objectives: SCAA DATED: 18.05.2023

1. To understand MapReduce programming architecture, processing models.
2. To understand and design MapReduce Programming using PIG and Hive
3. To understand and compare the architectural and processing of MapReduce Programming languages Pig, Hive and SPARK

Expected Course Outcomes:

1	Understand distributed, MapReduce Processing architectures	K2
2	Configure and setup MapReduce Processing architectures Ecosystem – Hadoop, Spark , Pig and Hive	K1, K2
3	Understand and write MapReduce program using Pig and Hive, SPARK	K3
4	Critically Analyze dataset using Pig , Hive and SPARK and suggest MapReduce Programming models based on domains specific applications	K3
5	Design and setup a Big Data Analytics Ecosystem for specific Business scenarios.	K4 , K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Big Data Framework**	**12-- hours**

Introduction to Big Data – Distributed file system –,Hadoop Storage [HDFS], Common Hadoop Shell commands - Anatomy of File Write and Read, NameNode, Secondary NameNode, and DataNode - Map Reduce Architecture -Hadoop Configuration: Environment : Steps – Hadoop 1.0 Version VsHadoop 2.0 YARN – Setting up Hadoop Eco System – Oozie – FLUME- STORM – FLUME - Pig Configuration – Hive Configuration - SPARK Configuration – Integration – Hadoop with R – Hadoop with Python

Unit:2	**PIG : MapReduce**	**12-- hours**

Pig Introduction: Overview of Pig - Pig Architecture - Pig Execution modes, Pig Grunt shell and Shell - commands. Pig Latin Basis: Data model, Data Types, Operator - Pig Latin Commands - Load & Store, Diagnostic Operators, Grouping, Cogroup, Joining, Filtering, Sorting, Splitting - Built-In Functions, User define functions.- Pig Execution Modes – Batch Mode – Embedded Mode – Pig Execution in Batch Mode – Embedding Pig in Python – Use cases - Map Reduce programs with Pig – Pig Vs SQL

Unit:3	**Hive: Map Reduce - CURD**	**10-- hours**

Introduction of Hive - Hive Features - Hive architecture -Hive Meta store - Hive data types – Hive Tables - Table types - Creating database , Altering database, Create table, alter table, Drop table, - Built-In Functions - Built-In Operators, User defined functions –

Unit:4	**Hive: Aggregation and Indexing**	**12-- hours**

HiveQL–Introduction to HiveQL, HiveQL Select, HiveQL – MapReduce using HiveQLOrderBy,Group By Joins, LIMIT, Distribute By , Cluster By - Sorting And Aggregation – Partitioning – Static –Dynamic – Index Creation - Bucketing – Analysis of MapReduce execution – Hive Optimization – Setting Hiving Parameters. – Usecase :MapReduce using Hive QL – HiveQLVs SQL

Unit:5	**SPARK Query**	**12-- hours**

SPARK – MapReduce - RDD Transformations – SPARK Operations – Usecase with SPARK and Comparison - MapReduce – Python – R – Pig – Spark – Hadoop - Limitations – Advantage – SPARK vsHadoop – SPARK Vs Pig and Hive – MapReduce- Spark Transformations		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60-- hours**

Text Book(s):

1	Boris Lublinsky Kevin T. Smith Alexey Yakubovich,ProfessionalHadoop® Solutions, Wiley, ISBN: 9788126551071,2015.
2	Chris Eaton, Dirk deroos et al., "**Understanding Big data**", McGraw Hill, 2012.
3	Tom White, "**Hadoop: The Definitive Guide**", O'Reilly Media 3rd Edition, May 6, 2012
4	Donald Miner, Adam Shook, "**MapReduce Design Patterns**", O'Reilly Media November 22, 2012
5	Edward Capriolo,DeanWampler,Jason Rutherglen, "**Programming Hive**", O'Reilly Media; 1 edition , October, 2012
6	Deepak Vohra, "Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-Related Frameworks and Tools" First Edition, Apress Publisher, ISBN: 9781484221983, 2016
7	Alan Gates, "**Programming Pig**", O'Reilly Media; 1st Edition,October, 2011

Reference Books:

1	Sridhar Alla**, "Big Data Analytics with Hadoop 3",** First Edition, ISBN: 978-1-78862-884-6, 2018, [Packt]
2	Naresh Kumar, **"Modern Big Data Processing with Hadoop",** ISBN: 9781787122765, 2018, [Packt]
3	NeerajMalhotra, **"Data Engineering Skills - Hadoop Shell: A Comprehensive Guide to Hadoop FS Commands",** First Edition, CreateSpace Independent Publishing, ISBN: 9781717577511, 2018
4	VigneshPrajapati, **"Big Data Analytics with R and Hadoop",** First Edition, ISBN: 978-1-78216-328-2, 2013, [Packt]
5	Edward Capriolo, "**Programming Hive: Data Warehouse and Query Language for Hadoop",** First Edition, O'Reilly MediaPublisher, ISBN**:** 9781449319335, 2012

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

S. No	Course Title	Duration	Provider - Free
1.	Big Data Hadoop and Spark Developer – R Programming	26 hours	Simplilearn
2.	Intro to Hadoop and MapReduce	4 Weeks	Udacity
3.	Hadoop Platform and Application Framework	5 Weeks	Coursera

4.	Big Data Essentials: HDFS, MapReduce and Spark RDD	6 Weeks	Coursera
5.	Mining Massive Datasets	7 Weeks	edX

Web Link – Video

1. http://hadooptutorial.info/mapreduce-programming-model/
2. https://hadoop.apache.org/docs/r1.2.1/mapred_tutorial.html
3. https://hadoop.apache.org/docs/current/hadoop-mapreduce-client/hadoop-mapreduce-client-core/MapReduceTutorial.html
4. https://www.edureka.co/blog/mapreduce-tutorial/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M	M	-	-	-	-	M	-	-
CO2	S	S	S	S	M	S	-	M	M	M
CO3	M	M	M	S	-	-	-	M	-	M
CO4	S	S	S	S	M	M	S	L	M	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PRACTICAL V : BIG DATA ANALYTICS LAB	L	T	P	C
Core/Elective/Supportive		Core			5	4
Pre-requisite		Basics of Programming	Syllabus Version		2025-2026	

Course Objectives:

1. To understand MapReduce programming architecture, processing models.
2. To understand and design MapReduce Programming using PIG and Hive
3. To understand and compare the architectural and processing of MapReduce Programming languages Pig, Hive and SPARK

Expected Course Outcomes:

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

1	Configure and setup MapReduce Processing architectures Ecosystem – Hadoop, Spark, Pig and Hive	K1, K2
2	Create a MapReduce program using Pig and analyse dataset using Pig Latin Scripts	K3,K4,K5,K6
3	Apply Hive commands on a dataset	K3
4	Develop a MapReduce program using SPARK	K3,K4 , K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

LIST OF PROGRAMS	75 hours

1. Installation of Hadoop, Spark, Pig and Hive
2. File Management tasks in Hadoop
3. Word Count Map Reduce program to understand Map Reduce Paradigm
4. Pig Latin scripts to sort, group, join, project, and filter your data.
5. Hive Databases, Tables and Views
6. Hive Functions and Indexes
7. Hive UDFs (User Defined Functions)
8. Exercises on SPARK MapReduce

Expert lectures, online seminars – webinars

Total Lecture hours	75 hours

Text Book(s):	
1	Boris Lublinsky Kevin T. Smith Alexey Yakubovich,ProfessionalHadoop® Solutions, Wiley, ISBN: 9788126551071,2015.
2	Chris Eaton, Dirk deroos et al., "**Understanding Big data**", McGraw Hill, 2012.
3	Tom White, "**Hadoop: The Definitive Guide**", O'Reilly Media 3rd Edition,May 6, 2012
4	Donald Miner, Adam Shook, "**MapReduce Design Patterns**", O'Reilly Media November 22, 2012
5	Edward Capriolo,DeanWampler,Jason Rutherglen, "**Programming Hive**", O'Reilly Media; 1 edition , October, 2012
6	Deepak Vohra, "Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-Related Frameworks and Tools" First **Edition,** Apress Publisher, ISBN: 9781484221983, 2016
7	Alan Gates, "**Programming Pig**", O'Reilly Media; 1st Edition,October, 2011
Reference Books:	
1	Sridhar Alla**, "Big Data Analytics with Hadoop 3",** First Edition, ISBN: 978-1-78862-884-6, 2018, [Packt]
2	Naresh Kumar, **"Modern Big Data Processing with Hadoop",** ISBN: 978-1-78712-276-1, 2018, [Packt]
3	NeerajMalhotra, **"Data Engineering Skills - Hadoop Shell: A Comprehensive Guide to Hadoop FS Commands",** First Edition, CreateSpace Independent Publishing, ISBN: 9781717577511, 2018
4	VigneshPrajapati, **"Big Data Analytics with R and Hadoop",** First Edition, ISBN: 978-1-78216-328-2, 2013, [Packt]
5	Edward Capriolo, "**Programming Hive: Data Warehouse and Query Language for Hadoop",** First Edition, O'Reilly MediaPublisher, ISBN**:** 9781449319335, 2012

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]			
S. No	**Course Title**	**Duration**	**Provider - Free**
1.	Big Data Hadoop and Spark Developer – R Programming	26 hours	Simplilearn
2.	Intro to Hadoop and MapReduce	4 Weeks	Udacity
3.	Hadoop Platform and Application Framework	5 Weeks	Coursera
4.	Big Data Essentials: HDFS, MapReduce and Spark RDD	6 Weeks	Coursera
5.	Mining Massive Datasets	7 Weeks	edX
Web Link – Video			

1. http://hadooptutorial.info/mapreduce-programming-model/
2. https://hadoop.apache.org/docs/r1.2.1/mapred_tutorial.html
3. https://hadoop.apache.org/docs/current/hadoop-mapreduce-client/hadoop-mapreduce-client-core/MapReduceTutorial.html
4. https://www.edureka.co/blog/mapreduce-tutorial/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	-	M	-	M
CO2	M	M	M	S	-	-	-	M	-	M
CO3	S	S	S	S	M	M	S	L	-	S
CO4	S	S	S	S	S	S	S	S	-	S

*S-Strong; M-Medium; L-Low

Course code		**PRACTICAL VI : MACHINE LEARNING LAB**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**			5	4
Pre-requisite		Basics of Machine Learning	**Syllabus Version**		2023-2024	

Course Objectives:

The main objectives of this course are to:
1. Build models using classification algorithm for real world problems
2. Build models using clustering algorithm for real world problems
3. Create classification and clustering models
4. Test and evaluate the models

Expected Course Outcomes:

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

1	Understand the various supervised learning techniques	K2
2	Understand the theoretical concepts of linear methods	K2
3	Apply Supervised, Unsupervised and Semi Supervised learning algorithm	K4
4	Understand and apply the concept of Deep Learning	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF PROGRAMS	75 hours

Implement the following in Python:

1. Exercise to manipulate data using different queries
2. Exercises to load dataset into sci-kit learn
3. Exercise for Building models in sci-kit learn
4. Exercise to extract features from datasets
5. Exercise to implement Regression
6. Exercise to implement SVM Classifier
7. Exercise to implement K-Means Clustering
8. Exercises for Deep learning
9. Exercises to Build a data pipeline

1.

Total Lecture hours	75 hours

FOURTH SEMESTER

Project

Project is inclusive component of a programme, wherein under the guidance of a faculty member, a student is required to do an innovative work with the application of knowledge earned during the course of his/her study. The student is expected to do literature survey and carry out development and/or experimentation. Through the project work the student has to exhibit both analytical and practical skills. The student will have to do his/her project under the guidance of a faculty member from the same department unless specifically permitted by the HOD for an alternate arrangement.

i). The project work shall be pursued for a minimum of 16 weeks, normally during the fourth semester.

ELECTIVES

Elective - I

		SOCIAL MEDIA MINING	L	T	P	C
Core/Elective/Supportive		Elective	4			4
re-requisite		Nil	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. To understand how accurately analyze voluminous complex data set in social media and other sources
2. To understand the models and algorithms to process large data sets
3. To understand social behavior and recommendation challenges and methodologies

Expected Course Outcomes:

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

1	Understand the concepts of Graph Models, social communities	K1, K2
2	Understand the network models and measures to evaluate information	K3
3	Understand and apply algorithms to model data using graph and network structures and recommendations	K2,K5
4	Brief on algorithms on social data diffusion and apply for various domains	K2,K3, K4
5	Distinguish and Suggest the appropriate algorithms for domain specific applications for data modelling and information diffusion, Evaluate the algorithms for metrics	K4,K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Social Media Mining	12-- hours

Social Media Mining - Introduction – Atoms – Molecules – Interactions – Social Media mining Challenges - Graphs - Basics – Nodes – Edges – Degree of Distribution- Types –Directed – Undirected
– Weighted - Graph Connectivity - Tress and Forests – Bipartite graphs – Complete Graphs – Sub graphs – Planar Graphs - Graph Representation - Graph Traversal Algorithms – Shortest path algorithms Dijkstra's - Spanning tree algorithms – Prims - Bipartite matching - Ford-Fulkerson algorithm

Unit:2	Network Models	12-- hours

Network Models – Measures – Node : Eigen Centrality – Page Rank – Group Measures – Betweenness centrality - group degree centrality, centrality, and group - Closeness centrality - Node Linking Behavior - Transitivity and reciprocity - Linking Analysis - Cluster coefficient – Jaccard - Case Study : -Modeling small networks with real world model

Unit:3	Social Media Communities	12-- hours

Social media Communities – Social Communities – Member based Detection – Node degree – Node Similarity – Node reachability - Group Based detection methods - balanced – robust - modular – dense - hierarchical - Spectral Clustering : Balanced Community algorithm Community Evolution - Evaluation.

Unit:4	Social Network	10-- hours

Social Network – Information Diffusion – Types - herd behavior - information cascades diffusion of innovation – epidemics – Diffusion Models Case Study – Herd Behavior – Information Cascades Methods – Social Similarity – assortativity – Social Forces - Influence homophily – Confounding - Assortativity measures – Influence measures – Predictive Models		
Unit:5	**Recommender System**	**12-- hours**
Recommendation Vs Search – Recommendation Challenges – Recommender algorithms - Content-Based Methods- Collaborative Filtering – Memory Based – Model Based – Social Media Recommendation – User friendship – Recommendation Evaluation – Precision – Recall – Behavioral– User Behavior – User – Community behavior – User Entity behavior – Behavioral Analytics - Methodology		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		

	Total Lecture hours	SCAA DATED: 16-5-2023 **60 hours**

Text Book(s)	
1	Reza Zafarani , Mohhammad AliAbbasi – Social Media Mining: An Introduction – Published by Cambridge press, 2014 – (Free Ebook available http://dmml.asu.edu/smm/chapter)
2	**Memon**, N., **Xu**, J.J., **Hicks**, D.L., **Chen**, H. (Eds.), Data Mining for Social Network Data- Springer – Annals of Information Systems ,ISBN 978-1-4419-6287-4
3	Lam Thuy Vo, 2019, "Mining Social Media: Finding Stories in Internet Data
Reference Books : EBooks	
1	Matthew A. Russel and Mikhail Klassen, 2018, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Instagram, GitHub
2	GungorPolatkan, AntonoisChalkiopoulos, P. Oscar Boykin et.al., 2018, "Social Media Mining and Analytics.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]			
	Course Title	**Duration**	**Provider**
1.	Social Media Data Analytics (Free)	4 Weeks	Coursera
2.	Introduction to Social Media Analytics	4 Weeks	Coursera
3.	Social Media Analytics: Using Data to Understand Public Conversations	3 Weeks	Future Learn
4.	Starting with social network analysis	2 hours	Udemy
Web link			

1. https://learn.g2.com/social-media-data-mining
2. https://www.javatpoint.com/social-media-data-mining
3. https://www.igi-global.com/dictionary/applying-critical-theories-to-social-media-mining-and-analysis/50376
4. https://www.cambridge.org/core/books/social-media-mining/introduction/75F143896832B7B9339F2CE663C4815B

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	L	-	-	-	S	S	L	-
CO3	L	S	-	M	S	-	M	L	M	L
CO3	S	M	M	-	M	L	L	-	-	M
CO4	-	L	M	S	L	-	-	-	-	-
CO5	S	M		-	-	L	-	L	M	S

*S-Strong; M-Medium; L-Low

Course code		DESIGN THINKING AND PROBLEM SOLVING	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		Basics of Logical & Reasoning Skills	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Learn critical thinking and its related concepts
2. Learn design thinking and its related concepts
3. Develop Thinking patterns, Problem solving & Reasoning

Expected Course Outcomes:

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

1	Understand the concepts of Critical thinking and its related technology	K1,K2
2	Focus on the explicit development of critical thinking and problem solving skills	K2,K3
3	Apply design thinking in problems	K3,K4
4	Make a decision and take actions based on analysis	K4,K5
5	Analyze the concepts of Thinking patterns, Problem solving & Reasoning in real time applications	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	CRITICAL THINKING	12 hours

Critical Thinking: Definition, Conclusions and Decisions, Beliefs and Claims, Evidence – finding, evaluation, Inferences, Facts – opinion, probable truth, probably false, Venn diagram. Applied critical thinking: Inference, Explanation, Evidence, Credibility, Two Case Studies, critical thinking and science, critical evaluation, self assessment.

Unit:2	DESIGN THINKING	12 hours

Design Thinking: Introduction, Need of Design Thinking, problem to question - design thinking process, Traditional Problem Solving versus Design Thinking, phases of Design Thinking, problem exploration, Stake holder assessment, design thinking for manufacturers, smart Idea to implementation.

Unit:3	CASE STUDY	12 hours

Thinking to confidence, fear management, duty Vs passion, Team management, Tools for Thinking, prototype design, Relevance of Design and Design Thinking in engineering, human centered design, case study: apply design thinking in problem.

Unit:4	PROBLEM SOLVING	10 hours

Problem solving: problem definition, problem solving methods, selecting and using information, data processing, solution methods, solving problems by searching, recognizing patterns, spatial

reasoning, necessity and sufficiency, choosing and using models, making choices and decisions.		
Unit:5	**REASONING**	**12 hours**
Reasoning: Deductive and hypothetical reasoning, computational problem solving; generating, implementing, and evaluating solutions, interpersonal problem solving. Advanced problem solving: Combining skills – using imagination, developing models, Carrying out investigations, Data analysis and inference. Graphical methods of solution, Probability, tree diagrams and decision trees		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	John Butterworth and Geoff Thwaites, Thinking skills: Critical Thinking and Problem Solving, Cambridge University Press, 2013.
2	H. S. Fogler and S. E. LeBlanc, Strategies for Creative Problem Solving, 2nd edition, Pearson, Upper Saddle River, NJ, 2008.
Reference Books	
1	A. Whimbey and J. Lochhead, Problem Solving & Comprehension, 6th edition, Lawrence Erlbaum, Mahwah, NJ, 1999.
2	M. Levine, Effective Problem Solving, 2nd edition, Prentice Hall, Upper Saddle River, NJ, 1994.
3	Michael Baker, The Basic of Critical Thinking, The Critical Thinking Co press, 2015.
4	David Kelley and Tom Kelley, Creative Confidence, 2013.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/critical_thinking/index.htm
2	https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm
3	https://nptel.ac.in/courses/109/104/109104109/
Course Designed By:	

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

		TEXT ANALYTICS	L	T	P	C
Core/Elective/Supportive		Elective	**4**			**4**

Pre-requisite	Basics of Text Analysis	**Syllabus**	**2025-2026**

Course Objectives:

1. To understand the text mining and NLP techniques.
2. To understand and applyprobabilistic models, clustering and classification for text analytics.
3. To understand and apply text analytics approaches in different domains.
4. To understand representation and handling of opinions by people in different ways.
5. To analyse different challenges in sentiment analysis and aspect-oriented sentiment analysis classification and analyse fake opinion detection and intention classification

Expected Course Outcomes:

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

1	Understand the concepts of text mining and text pre-processing techniques	K1, K2
2	Apply the probabilistic models, clustering and classification for text analytics	K3
3	Design a text analytic framework to analyze text data for domain specific applications	K4, K5 K6
4	Introduction to sentiment analysis and its applications	K1,K2
5	Create different types of opinion summary from the given data sources	K1,K3
6	Identifying opinion quality, author intention and fake opinions	K1,K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	**Text Mining**	**10-- hours**

Text Mining - Definition - General Architecture – Core Text mining Operations. Nature of unstructured and semi-structured text, collecting documents NLP: Text pre-processing-Sentence Segmentation tokenization - lemmatization - stemming - Parsing text - keywords- POS, Bag of Words Model, n-grams, chunking and Named Entity Recognition (NER) Corpus - sentence boundary determination - Textual information to numerical vectors -vector generation for prediction- document standardization and Representation – Inverted Index-term document matrix (TDM)-TDM Frequency

Unit:2	**Information retrieval and Extraction**	**12-- hours**

Information retrieval- keyword search - Vector space scoring, Models - web- based document search-matching-inverted lists. Information extraction-Architecture - Co-reference - Named Entity and Relation Extraction-Template filling and database construction –Applications. Inductive -Unsupervised Algorithms for Information Extraction.

Text Categorization – Definition – knowledge engineering,Text Classification, Feature Selection for Text Classification, Gini Index, Information Gain. Evaluating model: confusion matrix, class specific measure Classification models: Decision Tree Classifiers -Rule- based Classifiers - Naive Bayes Classifiers - Methods for Text Clustering –Distance and similarities

.

Unit:3	Probabilistic Models for Text Mining	12-- hours

Probabilistic Models: Introduction, Mixture Models, Stochastic Processes in Bayesian Nonparametric Models, Graphical Models, Probabilistic Models with Constraints, Parallel Learning Algorithms. Probabilistic Models for Information Extraction -Hidden Markov Models -Stochastic Context-Free Grammars - Maximal Entropy Modeling -Maximal Entropy Markov Models - Conditional Random Fields

Unit:4	Sentiment Analysis	12-- hours

Introduction: Sentiment Analysis Applications - Sentiment Analysis Research - Sentiment Analysis as Mini NLP. The Problem of Sentiment Analysis: Definition of Opinion - Definition of Opinion Summary - Affect, Emotion, and Mood - Different Types of Opinions - Author and Reader Standpoint. Document Sentiment Classification: Supervised Sentiment Classification - Unsupervised Sentiment Classification - Sentiment Rating Prediction - Cross-Domain Sentiment Classification - Cross-Language Sentiment Classification - Emotion Classification of Documents.

Unit:5	Subjectivity Classification and Challenges	12-- hours

Subjectivity - Sentence Subjectivity Classification - Sentence Sentiment Classification - Dealing with Conditional Sentences - Dealing with Sarcastic Sentences - Cross-Language Subjectivity and Sentiment Classification - Using Discourse Information for Sentiment Classification - Emotion Classification of Sentences. Subjectivity classification and Aspect Based sentiment classification. Sentiment Lexicon Generation: Dictionary-Based Approach - Corpus-Based Approach - Desirable and Undesirable Facts. -

Use Cases: Detecting Fake or Deceptive Opinions: Different Types of Spam - Supervised Fake Review Detection - Supervised Yelp Data Experiment - Automated Discovery of Abnormal Patterns - Model-Based Behavioral Analysis - Group Spam Detection - Identifying Reviewers with Multiple User ids - Exploiting Business in Reviews - Some Future Research Directions.

Unit:6	Contemporary Issues	2-- hours

Challenges of text analytics approaches for regional specific languages

	Total Lecture hours	60-- hours

Text Book(s)

1	Murugan Anandarajan "Practical Text Analytics: Maximizing the Value of Text Data", Springer; 2018
2	Charu C. Aggarwal Machine Learning for Text 2018
3	Steven Bird, Ewan Klein and Edward Loper" Natural Language Processing with Python"
4	Bing Liu "Sentiment Analysis: Mining Opinions, Sentiments and Emotions, Cambridge University Press, 2015.

Reference Books

1	Markus Hofmann, Andrew Chisholm "Text Mining and Visualization: Case Studies Using Open-Source Tools,", CRC press, Taylor & Francis,2016
2	Charu C. Aggarwal ,Cheng Xiang Zhai, Mining Text Data, Springer; 2012
3	Dipanjan Sarkar Text Analytics with Python, 2016
4	Bing Liu "Sentiment Analysis and Opinion Mining, Morgan & Claypool Publishers, 2012.
5	Erik Cambria, Dipankar Das "A Practical Guide to Sentiment Analysis" Springer, 2017.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Business Analytics & Text Mining Modelling Using Python, IIT Roorkeehttps://swayam.gov.in/
2	Natural Language Processing, IIT Kharagpurhttps://swayam.gov.in/
3	Text Mining and Natural Language Processing in Rhttps://www.udemy.com/
Course Designed By:	

Course code		DIGITAL MARKET ANALYTICS	L	T	P	C
Core/Elective/Supportive		Core	4			4
Pre-requisite		Basics of Market Analytics	Syllabus	2025-26		

Course Objectives:

To learn effective problem solving methodologies in Computing applications.
To introduce the principles and strategic concepts of marketing analytics.
To understand cost concepts (TOTAL HOURS - fixed - variable) - profit

margins - and lifetime value of the customer.

4. To get an overview of the benefits and objectives of quantitative marketing.

Expected Course Outcomes:

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

1	Understand the fundamentals of Marketing Analytics	K1,K2
2	Understand the Market segmentation and competitive Analysis	K2,K3
3	Apply, Analytics-based strategy selection and Business Operations	K3,K4
4	Apply the concepts of Product and Service Analytics and Pricing techniques and assessment	K4,K5
5	Explore the concepts of Analytics-based channel evaluation and selection Promotion Analytics , Promotion budget estimation and allocation	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction	10 hours

Introduction: Introduction to Marketing Analytics – Market Insight – Market sizing and trend analysis.

Unit:2	Market Segmentation	12 hours

Market Segmentation: Market segmentation – Segment identification - analysis - and strategy - Competitive analysis- Competitor identification - analysis and strategy.

Unit:3	Business Strategy and Operations	12 hours

. Business Strategy and Operations: Business Strategy - Analytics-based strategy selection - Business Operations - Forecasting - predictive analytics - and data mining.

Unit:4	Product - Service and Price Analytics	12 hours

Product - Service and Price Analytics: Product and Service Analytics - Conjoint analysis and product/service metrics - Price Analytics - Pricing techniques and assessment.

Unit:5	Distribution and Promotion Analytics	13 hours

Distribution and Promotion Analytics: Distribution Analytics - Analytics-based channel evaluation and selection - Promotion Analytics - Promotion budget estimation and allocation. Sales Analytics and Analytics in Action: Sales Analytics - Metrics for sales - profitability - and support- Analytics in Action - Pivot tables and data-driven presentations.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Stephan Sorger - "Marketing Analytics: Strategic Models and Metrics" - 1st Edition - Create Space Independent Publishing Platform - 31-Jan- 2013.
2	Stephan Sorger - "Marketing Planning: Where Strategy Meets Action" - 1st Edition - Prentice Hall PTR - 03-Sep-2011.
3	Cesar A.Brea - "Pragmalytics : Practical approaches to the Marketing analytics in the Digital Age" -1st Edition - iUniverse - 2012.
Reference Books	
1	Jr Joseph F. Hair , **Dana E. Harrison and** Haya Ajjan - Essentials of Marketing Analytics | 1st Edition Paperback – 11 July 2024
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial
Course Designed By:	

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	M	S	M	M	S
CO2	S	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Elective - II

		HEALTH CARE DATA ANALYTICS	L	T	P	C
Core/Elective/Supportive		**Elective**	**4**			**4**
Pre-requisite		**Basics on Statistics and Linear Algebra**	**Syllabus Version**		**2025-2026**	

Course Objectives:

1. To understand the Process ,Concepts and Procedures in Health Care Data Digital Systems
2. Understand Data standards used in Health Care Domain
3. Design Integrated Health Care Data Models for Data Analytics
4. Understand and Remember the Ethics of Managing and Analyzing Health Care Data

Expected Course Outcomes:

CO1	Understand the Process and Data Functionalities of Health Care Data	K1, K2
CO2	Understand the various Data Sources, diagnostic standards and Components of Data Analytics	K2, K1
CO3	Understand and design Integrated Data model for Analytics	K2, K5
CO4	Apply ETL for data analysis and create dashboards	K3, K4
CO5	Create and evaluate prediction models in healthcare applications for preventive care and personalized medicines	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Health Care Systems**	**12-- hours**

Introduction :Health Care Entities – Electronic Health Care Records – Clinical Data - Health Care Big Data Sources– Patient Data – Administrative Data – Genomics Data – Imaging Data- Insurance Data – Diagnostic Data – Clinical Data— Social Media – Survey Data – Family Data – Data Quality – Data Ethics – Data Integration Challenges

Unit:2	**Data Models and Data Standards**	**12-- hours**

Data Models : Relational Models – Hierarchical Models — Data warehousing Models – Star Schema – Normalized Data and Deformalized – Health Care Knowledge Representation Ontologies – Diagnosis Standards – ICD 9/10 - DSMI – DSM II –Drug Standards SNOWMED –LOINC – Laboratory Standards – Data Challenges in Data Mapping -Data Standards as Linked Data

Unit:3	**Big Data and Data Analytics**	**10-- hours**

Data Analytics: Data Cleaning and Pre-Processing – Data Processing and Modeling - Classification – Clustering – Dimensionality Reduction - Prediction Machine Learning – Microsoft Azure Cloud -Data Visualizing – Histogram – Boxplot- Scatter Plot – Bar – Pie – Mosaic Plot – Trends Lines – Heat Maps – Density Plots - Dashboard – Creation - Presentation

Unit:4	**Advanced Health Care Analytics**	**12-- hours**

Genomics Data Analysis – Microarray Data – Sequence Data – Research Survey Analysis – Text Mining – Tele Health – Virtual Health Care Assistance

Unit:5	**Health Care Usecase**	**12-- hours**

Prediction of Risk of Co morbidity Individuals – Outbreak – Epidemics - Personalized Medical Care – Pharmaceuticals and Patient Data Integration – Clinical Data

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**60-- hours**

Text Books:	
1	Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006
2	Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
3	Ethem Alpaydin, “Introduction to Machine Learning 3(Adaptive Computation and Machine Learning Series)”, Third Edition, MIT Press, 2014
4	Tom M Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2013.
Reference Books	
1	Jannes Klaas, “Machine Learning for Finance”, ISBN: 978178936364, 2019 [Packt]
2	Giuseppe Bonaccorso, “Machine Learning Algorithms”, Second Edition, ISBN: 2018 [Packt]
3	Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009
4	Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008
5	Yuxi Liu, “Python Machine Learning By Example”, 2017 [Packt]
6	John Paul Mueller, Luca Massaron, “Machine Learning (in Python and R) For Dummies”, First Edition, Wiley Publisher, ISBN: 9788126563050, 2016
7	U Dinesh Kumar ManaranjanPradhan,,“Machine Learning using Python”.) Publisher: Wiley, ISBN: 9788126579907, 2019

Online Course:			
S. No	**Course Title**	**Duration**	**Provider -Free**
1.	Machine Learning	12 hours	Simplilearn
2.	Machine Learning for Data Analysis	4 Weeks	Coursera
3.	Machine Learning Foundations: A Case Study Approach	6 Weeks	Coursera
4.	Machine Learning : Regression	6 Weeks	Coursera
5.	Introduction to Machine Learning	12 Weeks	Swayam -NPTEL
6	Deep Learning Specialization	4 Courses	Coursera

Web Link - Video:

1. https://www.packtpub.com/data/hands-on-machine-learning-with-scikit-learn-and-tensorflow-2-0-video
2. https://www.packtpub.com/data/machine-learning-projects-with-tensorflow-2-0-video
3.https://www.packtpub.com/application-development/complete-machine-learning-course-python-video

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	-	-	-	S	S	S	S
CO2	M	M	M	S	-	-	S	S	S	S
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	S	S	S	S	-	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		BLOCK CHAIN TECHNOLOGY	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		Basics of Block Chain & Crypto Currency	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Understand the fundamentals of block chain and cryptocurrency.
2. Understand the influence and role of block chain in various other fields.
3. Learn security features and its significance.
4. Identify problems &challenges posed by Block Chain.

Expected Course Outcomes:

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

1	Demonstrate blockchain technology and crypto currency	K1,K2
2	Understand the mining mechanism in blockchain	K2
3	Apply and identify security measures, and various types of services that allow people to trade and transact with bitcoins	K3,K4
4	Apply and analyze Blockchain in health care industry	K4,K5
5	Analyze security, privacy, and efficiency of a given Blockchain system	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	12 hours

Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major application: currency, identity, chain of custody.

Unit:2	NETWORK AND SECURITY	12 hours

Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain.

Unit:3	CRYPTOCURRENCY	12 hours

Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain

Unit:4	CRYPTOCURRENCY REGULATION	11 hours

Cryptocurrency Regulation - Stakeholders, Roots of Bit coin, Legal views - exchange of cryptocurrency - Black Market - Global Economy. Cyrptoeconomics – assets, supply and

demand, inflation and deflation – Regulation.		
Unit:5	**CHALLENGES IN BLOCK CHAIN**	**11 hours**
Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machine to machine communication – Data management in industry 4.0 – future prospects. Block chain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press (July 19, 2016).
2	Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies"
Reference Books	
1	Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System"
2	Rodrigo da Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh, "Blockchain Technology for Industry 4.0" Springer 2020.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/blockchain-tutorial
2	https://www.tutorialspoint.com/blockchain/index.htm
3	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/
Course Designed By:	

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

		DEEP LEARNING	L	T	P	C
Core/Elective/Supportive		Elective	**4**			**4**

Pre-requisite	**Nil**	**Syllabus**	**2025-26**

Course Objectives:

The main objectives of this course are to:

1. To understand the fundamental concepts of Deep Learning.
2. To understand the concepts of Deep Learning Categories.
3. To understand and apply Deep Learning concepts in real-time.

Expected Course Outcomes:

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

1	Understand the structure and model of Deep Learning	K2
2	Understand the concepts of Neural Network and its type.	K3
3	Understand and create workstation models using Python/tensorflow	K4
4	Understand and apply concepts of Deep Learning and Deep generative model.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	**Introduction: Deep Learning**	**12 hours**

Introduction to Deep Learning: Fundamentals of Deep Learning- Artificial Intelligence – Machine Learning – Learning process of neural Network - representation data - Methodology of Deep Learning - Data representation of Neural Networks – tensor operations – Gradient based optimization - Backpropagation components – Model Parameterization – Deep Learning hyperparameter – basic configuration.

Unit:2	**Neural Network**	**10 hours**

Anatomy of Neural Network – Introduction Keras - Setting up Deep Learning Workstation – Fundamentals of Machine Learning – Evaluating Machine Learning Models – Data Preprocessing – Feature Engineering – overfitting – Underfitting – Workflow of Machine Learning.

Unit:3	**Classification of Neural Network**	**12 hours**

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders - Regularization for Deep Learning, Optimization for Training Deep Models

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs

Unit:4	Deep Generative Models	12 hours
Deep Generative Models: Boltzmann Machines - Restricted Boltzmann Machines - Introduction to MCMC and Gibbs Sampling- gradient computations in RBMs - Deep Belief Networks- Deep Boltzmann Machines Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing - Other Applications		
Unit: 5	**Deep Learning: Practice**	**12 hours**
Deep Learning for Computer Vision – Training convents – Pretrained convnet – Visualizing convnet – Working with text data – Using word embeddings – Functional API – Text generation with LSTM – Implementing Deep Dream in Keras.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Abraham Silberchatz, Henry K.Forth, Sudharshan, “Database system Concepts”, 7th edition, McGraw Hill, 2020.
2	Prabu C.S.R, “Object-Oriented Database Systems: Approaches and Architectures” 3rd Edition, PHI, 2011.
3	Kristina Chodorow , “MongoDB: The Definitive Guide”, 3rd Edition , O'Reilly Media, ISBN: 9781491954461, 2019.
4	Guy Harrison, “Next Generation Databases: NoSQL, NewSQL, and Big Data”,Apress, 2016.

Reference Books	
1	ShamkantB.Navathe, RamezElamsri"Fundamentals of Database Systems", 7th Edition, Pearson Education Limited, 2017.
2	David Hows , Peter Membrey , EelcoPlugge , Timm Hawkins , “The Definitive Guide to MongoDB”, 3rd Edition, Apress, 2015.
3	GauravVaish ,“Getting Started with NoSQL”Packt Publishing, 2013.
4	Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1. Deep Learning Specialization, https://www.coursera.org/specializations/deep-learning	
Course Designed By:	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	M	M	-	-	-	-	M	-	-
CO2	S	S	S	S	M	S	-	M	M	M
CO3	M	M	M	S	-	-	-	M	-	M
CO4	S	S	S	S	M	M	S	L	M	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		ROBOTIC PROCESS AUTOMATION FOR BUSINESS	L	T	P	C
Core/Elective/Supportive		Elective	4			4
Pre-requisite		Basics of Robots & its Applications	Syllabus		2025-26	

Course Objectives:

The main objectives of this course are to:

1. Learn the concepts of RPA, its benefits, types and models.
2. Gain the knowledge in application of RPA in Business Scenarios.
3. Identify measures and skills required for RPA

Expected Course Outcomes:

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

1	Demonstrate the benefits and ethics of RPA	K1,K2
2	Understand the Automation cycle and its techniques	K2
3	Draw inferences and information processing of RPA	K3,K4
4	Implement & Apply RPA in Business Scenarios	K5
5	Analyze on Robots & leveraging automation	K5,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION	12 hours

Introduction to RPA - Overview of RPA - Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA - Centre of Excellence – Types and their applications - Building an RPA team
- Approach for implementing RPA initiatives.

Unit:2	AUTOMATION	12 hours

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people.

Unit:3	AUTOMATION IMPLEMENTATION	12 hours

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows.

Unit:4	ROBOT	12 hours

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

Unit:5	**ROBOT SKILL**	**10 hours**

Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**60 hours**

Text Books

1	Alok Mani Tripathi" Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool" Packt Publishing Limited March 2018.
2	Tom Taulli "The Robotic Process Automation Handbook" Apress , February 2020.

Reference Books

1	Steve Kaelble" Robotic Process Automation" John Wiley & Sons, Ltd., 2018

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2	https://www.javatpoint.com/rpa
3	https://onlinecourses.nptel.ac.in/noc19_me74/preview

Course Designed By:

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Annexure

Regulations

Effective from the Academic year 2025 - 2026

1. OBJECTIVE OF THE PROGRAMME

To Develop the Post Graduates in COMPUTER SCIENCE-DATA ANALYTICS with strong knowledge of theoretical COMPUTER SCIENCE-DATA ANALYTICS subjects who can be employed in research and development units of industries and academic institutions.

2. ELEIGIBILITY FOR ADMISSION

A candidate who has passed B.Sc Computer Science/B.C.A/B.Sc Computer Technology/B.Sc Information Science/Technology degree of this University or any of the degree of any other University accepted by the syndicate as equivalent thereto subject to such conditions as may be prescribed therefore shall be permitted to appear and qualify for the M. Sc COMPUTER SCIENCE-DATA ANALYTICS degree examination of this University after a course of study of two academic years.

3. DURATION OF THE PROGRAMME

The programme for the degree of Master of Science in COMPUTER SCIENCE-DATA ANALYTICS shall consist of two Academic years divided into four semesters. Each semester consist of 90 working days.

1. QUESTION PAPER PATTER

2.

Time: Three Hours Maximum Marks: 75

Section A : 10 x 1 = 10 (One word Questions from each Unit)
Section B : 5 x 5 = 25 (Either or Type, One Question from each Unit)
Section C : 5 x 8 = 40 (Either or Type, One Question from each Unit)

GUIDELINES TO M.Sc (Computer Science with Data Anaytics) MAIN PROJECT REPORT PREPARATION

The students should strictly adhere to the following points while preparing their final project report.

Students are expected to undergo project work individually and submit individual project report.

Project reports should be typed / printed in double space using A4 size bond sheets with a left margin at column 10 and a right margin at column 75.

A page should not contain more than 25 lines. The source code should be loaded and made readily available in the system during Viva – Voce examination for verification by the examiners.

Table of contents should be in the specified format.

The students are asked to report to the concerned guides regularly during their project period to present their progress of work.