Credit Frame work for Master of Computer Applications (DS&AI) (NEP-2020)

School of Computer Applications, BBD University, Lucknow

Semester	Discipline Specific Core (DSC) (Major)	Discipline Specific Elective (DSE)(Major)	Generic Elective (GE)(Minor)	Co-Curricular (CC)	Vocational Course (VC)	Survey/Seminar/MOOC/Community Outreach (SSMC)	GP	Total Credit
1	6 Subjects 28 Credits (6+6+4+4+4+4 Credits)						1 Credit	29
2	6 Subjects 26 Credits (6+6+2+4+4+2+4 Credits)	1 Subject 4 Credits					1 Credit	31
3	4 Subjects 16 Credits (6+4+4+2 Credits) Dissertation 10 Credits	1 Subject 4 Credits					1 Credit	31
4	1 Subject 4 Credits Project 24 Credits (4+24 Credits)						1 Credit	29

Babu Banarasi Das University, Lucknow

School of Computer Applications

Master of Computer Applications (DS&AI)

Evaluation Scheme (w. e. f. Academic Session 2025-26)

SEMESTER I

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Course Total		
DSC	MCADSN21101	Python with Data Science	3	1	0	40	60	100	4	IBM
DSC	MCADSN21102	Java Programming	3	1	0	40	60	100	4	School
DSC	MCADSN21103	Soft Computing	3	1	0	40	60	100	4	
DSC	MCADSN21104	Relational Database Management System	3	1	0	40	60	100	4	
DSC	MCADSN21105	Linux Operating System	3	1	0	40	60	100	4	
DSC	MCADSN21106	Probability and Statistics	3	1	0	40	60	100	4	
DSC	MCADSN21151	Java Programming Lab	0	0	4	40	60	100	2	
DSC	MCADSN21152	Relational Database Management System Lab	0	0	4	40	60	100	2	
	GPN2101	General Proficiency	0	0	0	100	0	100	1	
Total			**18**	**6**	**8**	**420**	**480**	**900**	**29**	

SEMESTER II

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Course Total		
DSC	MCADSN22101	No SQL and MONGODB	2	0	0	40	60	100	2	IBM
DSC	MCADSN22102	Descriptive Analytics	3	1	0	40	60	100	4	IBM
DSC	MCADSN22103	Data Structure using Java	3	1	0	40	60	100	4	School
DSC	MCADSN22104	Web Technology & Application Development	3	1	0	40	60	100	4	
DSC	MCADSN22105	Data Warehousing and Data Mining	3	1	0	40	60	100	4	
DSC	MCADSN22106	Research Methodology	2	0	0	40	60	100	2	
DSE		Discipline Specific Elective-I	3	1	0	40	60	100	4	
DSC	MCADSN22151	Data Structure using Java Lab	0	0	4	40	60	100	2	
DSC	MCADSN22152	Web Technology & Application Development Lab	0	0	4	40	60	100	2	
DSC	MCADSN12153	Seminar & Term Paper (STP)	0	0	4	100	0	100	2	
	GPN2201	General Proficiency	0	0	0	100	0	100	1	
Total			**19**	**5**	**12**	**560**	**540**	**1100**	**31**	

SEMESTER III

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Course Total		
DSC	MCADSN23201	Big Data Analytics and Architecture	3	1	0	40	60	100	4	IBM
DSC	MCADSN23202	Artificial Intelligence	3	1	0	40	60	100	4	IBM
DSC	MCADSN23203	R Programming for Data Science	3	1	0	40	60	100	4	School
DSC	MCADSN23204	Simulation & Modeling	2	0	0	40	60	100	2	
DSE		Discipline Specific Elective-II	3	1	0	40	60	100	4	
DSC	MCADSN23251	R Programming for Data Science Lab	0	0	4	40	60	100	2	
DSC	MCADSN23252	Dissertation	0	0	0	40	60	100	10	
	GPN2301	General Proficiency	0	0	0	100	0	100	1	
Total			**14**	**4**	**4**	**380**	**420**	**800**	**31**	

SEMESTER IV										
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**	**Mode**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**		
DSC	MCADSN24201	Machine Learning	4	0	0	40	60	100	4	IBM
DSC	MCADSN24251	Project	0	0	0	250	450	700	24	School
	GPN2401	General Proficiency	0	0	0	100	0	100	1	
Total			**4**	**0**	**0**	**390**	**510**	**900**	**29**	
Discipline Specific Elective-I										
1	MCADSN22121	Optimization Techniques								
2	MCADSN22122	Cloud Computing								
3	MCADSN22123	Natural Language Processing								
4	MCADSN22124	Internet of Things								
Discipline Specific Elective-II										
1	MCADSN23221	Deep Learning								
2	MCADSN23222	Pattern Recognition								
3	MCADSN23223	Neural Network								

DSC	Discipline Specific Core
DSE	Discipline Specific Elective
GE	Generic Elective
CC	Co-Curricular
VC	Vocational Course
GP	General Proficiency
L	Lecture
T	Tutorial
P	Practical

MASTER OF COMPUTER APPLICATIONS (DS & AI)

FIRST SEMESTER

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**		I	
Course Name	Python with Data Science				
Code	MCADSN21101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Using the frameworks necessary to analyze and interpret data and acquire technical expertise using popular open-source analytics frameworks for Data Science.				

Course Outcomes	
CO1	Understand programming basics including functions, variables, and data type.
CO2	Data Science lifecycle revolve around using some techniques and other analytical methods to produce insights and predictions from data to achieve a business objective.
CO3	Applying and analyzing, is the process of determining which features might be useful in training a model, and then creating those features by transforming raw data found in log files and other sources.
CO4	Understand Data engineering and data modelling practices using machine learning and building and create role-playing challenge-based scenarios to propose real-world solutions

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction of Python**: What is Python, its advantages and disadvantages, how to run python scripts, how to use variables, String operator and functions, Inputting the data, Working with Boolean and other statements, Use of pandas library for data analysis, Different types of errors that one can encounter while working with Python.	15	CO1
2	**Introduction To Data Science:** What is Data Science, what does a data scientist do, various examples of Data Science in the industries, How Python is deployed for Data Science applications, Various steps in Data Science process like data wrangling, data exploration and selecting the Model	15	CO2
3	**Data Manipulation and Visualization:** Introduction to NumPy, Pandas and Matplotlib, how to Import NumPy module, what is a data Manipulation using library ? Series object in pandas, Data frame in Pandas, Loading an handling data with Pandas, Introduction to Matplotlib, Using Matplotlib for plotting Graphs and charts like Scatter, Bar, Pie, Line, Histogram and more.	15	CO3
4	**Supervised And Unsupervised Learning:** What is linear regression? Logistic Regression, what is **classification**? Decision Tree, Confusion Matrix, Random Forest, Naïve Bayes classifier, support vector machine, use cases of unsupervised learning, what is clustering and Types of clustering. What is K-means clustering and Hierarchical Clustering? Step by step calculation of k-means algorithm.	15	CO4

Suggested Readings

1. Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.
2. Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by Jason Bell.

Online Resources

1. https://cognitiveclass.ai/courses/python-for-data-science

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	2	1	2	1		1		1	2	1	2
CO2	1	3		2	2	1		1		2		3	2	3
CO3	1	3		3	3	3			1	1		2	2	3
CO4	2	3		1	2	2	1		1	3	1	3	2	3

Program	Master of Computer Applications (DS&AI)				
Year	I	**Semester**	I		
Course Name	JAVA Programming				
Code	MCADSN21102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course objective to establish a strong foundation in Java programming by enabling students to master fundamental syntax, apply object-oriented principles and focuses on developing enterprise-level applications by equipping students with the skills to create dynamic web applications using Servlets and JSP, connect and manage data through JDBC.				
Course Outcomes					
CO1	Appraise Java Programming Fundamentals and Illustrate OOP concepts to develop Java program for a given problem.				
CO2	Design event driven GUI and web related applications which mimic the real word scenarios.				
CO3	Understand the fundamental architecture and principles of JDBC and Perform basic database operations using JDBC APIs				
CO4	Understand advanced server-side programming concepts and use technologies like Servlets, JSP.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Object-Oriented Programming in Java:** Classes and Objects, Inheritance, Polymorphism, Abstraction, and Encapsulation, Method Overloading and Overriding; **Exception Handling:** Try-Catch Block, Throw, Throws, and Finally, Custom Exceptions; **Collections Framework:** List, Set, Map Interfaces, Array List; **Multithreading Basics:** Thread Class & Runnable Interface Thread Lifecycle, Synchronization & Inter- thread Communication;	15	CO1
2	**Event Handling:** Introduction to Event Handling**,** Delegation Event Model**,** Event Classes and Interfaces**,** Event Sources and Listeners**,** Adapter Classes, Custom Event Handling; **Java Swing:** Introduction to Swing vs AWT, Swing Component Hierarchy, Creating a Basic Swing Application, **Core Components:** JComponent, JLabel, JButton, JTextField, JTextArea, Advanced Components: JScrollBar, JSlider, JProgressBar, JList, JComboBox; **Containers and Panes:** JPanel, JRootPane, JDialog, JOptionPane; **Menus and Toolbars:** JMenu, JMenuBar, JMenuItem, JPopupMenu, ; **Layout Managers:** FlowLayout, BorderLayout, GridLayout, CardLayout;	15	CO2
3	**Java Database Connectivity (JDBC):** JDBC Introduction and Installation**,** JDBC Architecture and Driver Types**,** JDBC-ODBC Bridge**,** Driver Manager Class**,** Java SQL Package Overview**,** Connection and Statement Interfaces**,** PreparedStatement and CallableStatement**,** Executing Queries and Handling ResultSet**,** Mapping SQL and Java Data Types**,** ResultSetMetaData Interface**,** Handling SQL Exceptions**,** Advanced Connection Management**,** Introduction to LDAP (Lightweight Directory Access Protocol).	15	CO3

4	**Java Servlets:** Introduction to Server-Side Java**,** Servlet Architecture and Life Cycle**,** HTTP Protocol and HTTP Methods**,** Web Server vs Web Container**,** Servlet Interfaces: Servlet, GenericServlet, HttpServlet**,** ServletConfig and ServletContext**,** Request and Response Handling**,** Retrieving and Processing Form Data**,** Session Management (Cookies, URL Rewriting, HttpSession)**; JSP Basics:** Directives, Scripting Elements, and Expressions; JSP Implicit Objects and Custom Tags;	15	CO4

Suggested Readings

1. E. Balagurusamy, Programming with Java, Tata McGraw Hill.
2. Patrick Naughton and Herbertz Schildt, “Java 2.0: The Complete Reference”, TMH, 1999.
3. Deitel & Deitel, "Java How to program”, Prentice Hall, 4th Edition, 2000.
4. Gary Cornell and Cay S. Horstmann, "Core Java Vol 1 and Vol 2", TMH.
5. Java 6 Programming black books Kogent solutions published by dreamtech press edition 2007.
6. Steve Holzner, “Java black book”, Paraglyph Press; Second Edit ion (July 1, 2002)
7. Duncan A Buell, “Data Structures Using Java”, Jones & Bartlett Learning, January 2012
8. Robert Lafore, “Data Structures and Algorithms in Java”, Second Edition, SAMS, Second Edition, 2003.
9. Goodrich, “Data Structures & Algorithms in Java”, Sixth Edition, (January 2014).

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs92/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2	2	3	1		1	2	1	3	3	3
CO2	3	2	2	3	2	3	1		1	2	1	3	3	3
CO3	3	2	2	3	2	3	1		1	2	1	3	3	3
CO4	3	2	2	3	2	3	1		1	2	1	3	3	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**		I	
Course Name	Soft Computing				
Code	MCADSN21103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of the soft computing techniques to improve Data Analysis Solution is to strengthen the dialogue between the Statistics and soft computing research communities to cross-pollinate both fields and generate mutual improvement activities.				
Course Outcomes					
CO1	Understand how artificial intelligence influences various modern developments.				
CO2	Understand how Fuzzy System Controller controls various devices.				
CO3	Understand different types of Fuzzy System used in real world.				
CO4	Understand to develop high quality optimized Solution for a problem.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Soft Computing, Differences between Soft Computing and Hard Computing, Requirements of Soft Computing, Applications of Soft Computing Artificial Intelligence & Neural Network: Introduction to Artificial Intelligence, Models of Artificial Neural Network, Learning Rules and Various Activation Functions, Hebbian Learning Rule, Perception Learning Rule, Delta Learning Rule, Widrow – Hoff Learning Rule, Correlation Learning Rule, Winner – Take All Learning Rule, Associative Memories.	15	CO1
2	**Introduction to Fuzzy System:** Fuzzy System, Fuzzy Logic, Fuzzy Sets and Crisp Sets, Evolution of Fuzzy System, Fuzzy Set Operations, Fuzzy to Crisp Conversion, Inference in Fuzzy Logic, Fuzzy Rule Base, Fuzzy Knowledge Base, Fuzzy Controller, Fuzzification and Defuzzification.	15	CO2
3	**Type – II Fuzzy Set:** Need of Type – II Fuzzy Set, Type – II Fuzzy Set, Generalized Type – II Fuzzy Set, Interval Type- II Fuzzy Set, Fuzzy System, Fuzzy Knowledge Base Modeling Approach: Mamdani Approach, Takagi Sugeno's Approach, Interpretability and Accuracy Trade- Off in Fuzzy Knowledge Base System, Handling Interpretability and Accuracy Trade-Off in Fuzzy Knowledge Base System.	15	CO3
4	**Genetic Algorithm:** Basic Concept, Working Principle of Genetic Algorithm, Flow Chart of Genetic Algorithm, Genetic Representation (Encoding), Initialization and Selection, Genetic Operators, Mutation, Generation Cycle, Applications.	15	CO4

Suggested Readings

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

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs54/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		1				2			1	1	2	2	1
CO2	2	3	1	2		2	1		2			2	2	1
CO3	1	3	2	2		3	2		2			2		2

Program	Master of Computer Applications (DS&AI)				
Year	I	**Semester**		I	
Course Name	Relational Database Management System				
Code	MCADSN21104				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite	DBMS	3	1	0	4
Course Objectives	The objective of this course is to introduce the fundamental Concepts of RDBMS, terminologies of Relational database management system, E-R Modelling, SQL and PL/SQL concept, Query processing Database transactions and concurrency control techniques.				
Course Outcomes					
CO1	Understand the basic concepts of the Relational database and data models.				
CO2	Understand the fundamental concepts ER diagrams and map ER diagrams into Relations and the query language for effective data retrieval.				
CO3	Evaluate the alternative relation designs to determine which one is better according to selected criteria.				
CO4	Understand the basic concepts/features of database transactions and concurrency control techniques.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction of database and relational Data Base Management System, Database Management System vs. Relational Data Base Management System, Capabilities of good RDBMS (Codd's Rules), Architecture of Database Management Systems Database and Schemas, Instances; **Relational Database Management System & Data Modeling:** Relational Model, Hierarchal Model, Network Model**,** Their applications and difference, Structure of Relational Database, Relational model terminology: Relations, Domains, Attributes, Tuples, Relational Constraints and Keys.	15	CO1
2	**Entity- Relationship Model:** Entity Sets, Entity Types, Relationships between different entities, Entity-Relationship Model Concepts, Notation for E-R Diagram, Extended E-R Features, Reduction of E-R Diagram to Relation with example; Structured query Language (SQL): Characteristics of SQL, DML, DDL, DCL, SQL Data Types, Types of SQL Commands, Queries and Sub Queries, Aggregate Functions, Insert, Update and Delete Operations, Joins and their types, Unions, Intersection, Minus, View, PL/SQL, Cursors. Writing PL/SQL code using triggers	15	CO2

3	**Functional Dependencies and Normalization:** Functional dependency definition and explaining with mappings, Database Anomalies, Armstrong's axioms, Closure of Attribute sets, Normalization, Need of Normalization, Normal Forms, First Normal Form, Second Normal Form, Third Normal Forms, Boyce-Codd Normal Form, Multi value dependency, Fourth Normal Form ,Projection-join Normal Form with examples; **Relational Algebra:** Concepts of Relational Algebra, Fundamentals Operations: Select, Project, Rename, Union, Set difference, division, Cartesian Product, Additional Relational- Algebra Operations: Set Intersection, Joins. Introduction to relational calculus.	15	CO3
4	**Transaction Processing & Concurrency Control:** Basic concept; Introduction to Transaction, ACID properties; transaction state; Basic idea of serializability, view and conflict Serializability, Advantages of Serializability, Recovery and Recovery Techniques: Log Based Recovery, Shadow Paging, deferred database modification, immediate database modification, checkpoints; **Concurrency Control:** Purpose and meaning of concurrency, Two-Phase Locking (2PL), timestamp ordering, and multi- version concurrency control (MVCC). Address issues like lost updates, dirty reads, and incorrect summaries.	15	CO4

Suggested Readings

1. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill, Seventh Edition-2019
2. Date CJ, An Introduction to Database Systems, Addison Wesley, EightEdition-2017
3. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley, Seventh Edition-2017
4. Sanjeev Sharma, Jitendra Agrawal , Shikha Agrawal, Advanced Database Management System January 2017

Online Resources :

1. https://onlinecourses.nptel.ac.in/noc22_cs91/preview

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					1			1		1	2	2	1
CO2	1	2	3	1	3	2	1		3	2	2	2	2	2
CO3	1	1	2	3	2	2	2		3	2	2	2	2	3
CO4	2	2	1	2		2	1		1	1		2	1	2

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	I		
Course Name	Linux Operating System				
Code	MCADSN21105				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objectives of this course are to provide the in-depth coverage of various concepts of Linux. Linux administration is an essential course for the students.				
Course Outcomes					
CO1	Outline the basic concept of operating systems and understand the concepts and commands of Linux;				
CO2	Understand the file management and process manipulation in Linux;				
CO3	Understand the C environment under Linux and do the system administration and communication in Linux;				
CO4	Understanding the pipes and filter commands and develop shell programs in Linux.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Linux Operating System:** Introduction: History, Basic features, architecture, distributions. Installing Linux, Logging in / Logging out; **Linux File System:** Introduction to files, Organization, Assessing File systems, Structure – boot block, super block, inode block, data block; **Basic and Advanced Commands:** Directory oriented commands, File oriented commands, File access permissions: chmod, umask, chgrp, groups. General purpose commands.	15	CO1
2	**Linux File management and Compression:** Computer devices, Disk related commands: dd, du, df, dfspace, fdisk, compressing and uncompressing files; **Manipulating Processes and Signals:** Basics, process states and transitions, zombie and orphan processes, process oriented commands. Handling foreground and background jobs. ; **System calls:** Files related system calls for opening, creating, reading, writing, relocating file descriptors, closing, duplicating file descriptors, linking, unlinking, accessing file status information, checking permissions, changing ownership, groups and permissions of files; **Process related system calls:** exec, fork, wait, exit.	15	CO1 & CO2
3	**System Administration:** Booting and shutting down process. Creating, mounting and unmounting file systems; **Managing User accounts:** creating, modifying & deleting user accounts and groups; **Networking Tools:** Communication oriented commands. ping, nslookup, telnet, arp, netstat, route, ftp, trivial file transfer protocol, finger, rlogin. C language compiler, the make command and makefiles, general debugging techniques, debugging.	15	CO3

4	**File system interface:** File Concept, Access Methods, Pipes and filters: Connecting processes with pipes, redirecting input and output. Filters: sort, grep, egrep, fgrep, uniq, more, pr, cut, paste, tr; **Shell Programming:** Shell meaning & types; Introduction to shell scripting, shell variables, exporting shell variables, Escape mechanisms, Shell meta characters, read command, conditional statements, looping and case statements, expr statement, command line arguments, string handling, arrays, shell functions.	15	CO3 & CO4

Suggested Readings

1. Christopher Negus, “Linux Bible”, Wiley India Pvt. Ltd.
2. Goerzen John, Linux Programming Bible, IDG Books, New Delhi.
3. William Stallings, “Operating Systems: Internal and Design Principles”, PHI.
4. Sumitabha Das, "Your Unix/Linux - The Ultimate Guide," McGraw Hill.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105214/
2. https://onlinecourses.nptel.ac.in

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					2				1		3	2	
CO2	2	3	1	2	1	1	1			2		3	2	3
CO3	3	2	1	3		1	1			2	1	3	2	2
CO4	2	2		2	2	2			1	2	1	3	2	2

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**		I	
Course Name	Probability & Statistics				
Code	MCADSN21106				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Subjects analyze relevant statistical measures for different types of data & use the basic probability concept & Methods of sampling and testing hypotheses.				
Course Outcomes					
CO1	To apply statistical distributions methods for real life problems.				
CO2	To Implement the concept of probability.				
CO3	To draw & demonstrate valid inferences based on the analysis of statistical data.				
CO4	To Implement the various techniques of testing of hypothesis.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Measurement of Central Tendency:** Concept of Central Tendency, Types of Central Tendency: Arithmetic Mean, Geometric Mean, Harmonic Mean, Median and Mode; **Measures of dispersion**: Concept of dispersion, Absolute and Relative Measures of Dispersion: Range, Quartile, Inter Quartile Range, Mean Deviation, Standard Deviation **Correlation and Regression:** Concept and types of correlation: Karl Pearson's, Spearman's Rank correlation, Linear Regression: Concept and line of best fit (Y on X and X on Y).	15	CO1
2	**Probability and Expected Value:** Experiment, Sample Space, Event, Types of Events, Probability, Classical Approach, Subjective Approach, Axiomatic Approach & Modern Definition; Probability Theorems (Additive, Multiplicative), Conditional Probability, Bayes's Theorem, Mathematical Expectation, Random Variable & Probability Distribution of Random Variable.	15	CO2
3	**Theoretical Distributions:** Meaning of Theoretical Distributions, Difference between Theoretical & Observed Frequency Distributions, Binomial Distribution, Properties and Constants of Binomial Distribution; Poisson Distribution, Characteristics, Properties and Constants of Poisson Distribution, Poisson Distribution as an Approximation of Binomial Distribution; Normal Distribution, Properties and Constants of Normal Distribution, Relation between Binomial, Poisson & Normal Distribution; **Sampling:** Population or Universe, population size, types of population, objective of sampling, methods of sampling.	15	CO3

4	**Statistical Hypothesis**: Types of hypotheses, Procedure of testing the hypothesis, Types of Error, Level of Significance, Degree of freedom. Chi-Square Test, Student's t-Distribution, Analysis of Variance, F-Test; **Statistical Quality Control**: Introduction, Types of Control Charts, X-Bar Chart, R Chart, C-Chart, Advantages and Limitations of SQC.	15	CO4

Suggested Readings

1. S. C. Gupta, "Fundamental of Statistics ", Second Edition.
2. Roy D. Yates and David J. Goodman, "Probability and Stochastic Processes-A friendly introduction for Electrical & Computer Engineers, Second Edition.
3. V.K. Rohatgi,"A Introduction to probability and Mathematical Statistics" ,Wiley Eastern Ltd. New Delhi.

Online Resources

1. https://archive.nptel.ac.in/courses/111/105/111105077/
2. https://onlinecourses.nptel.ac.in/noc22_cs120/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	1	1				1	2	1		2
CO2	2	2	2	2	1	1					1			2
CO3	2	2	2	2	2	1					1			2
CO4	3	2	2	3	2	1				2	2			2

Program	Master of Computer Applications (DS&AI)				
Year	I	**Semester**		I	
Course Name	Java Programming Lab				
Code	MCADSN21151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To provide practical knowledge about various concepts of programming and to make the student learn programming with Java language and problem-solving techniques.				
Course Outcomes					
CO1	To understand and implement basic java programs.				
CO2	To understand and implement exception handling, object-oriented programming, multi-threading and GUI programming.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Write a Java program to print "Hello World" and demonstrate command-line compilation and execution. 2. Write a Java program to perform arithmetic operations (addition, subtraction, multiplication, division) using user input. 3. Write a Java program to demonstrate control structures (if-else, switch-case) for grade calculation. 4. Write a Java program to find the largest and smallest elements in an array. 5. Write a Java program to implement string operations: concatenation, comparison, substring extraction, and case conversion. 6. Write a Java program to create a class Rectangle with data members for length and breadth, methods to calculate area and perimeter, and demonstrate object instantiation. 7. Write a Java program to demonstrate constructor overloading and method overloading. 8. Write a Java program to implement inheritance with base class Person and derived class Student, and display details. 9. Write a Java program to implement method overriding and dynamic method dispatch (runtime polymorphism). 10. Write a Java program to demonstrate abstract classes and abstract methods. **Notes**: Students will also perform all other exercises provided by course instructor. **Note:** Students will also perform all other exercises provided by course Instructor.	15	CO1

2	1. Write a Java program to demonstrate interfaces and implement multiple inheritance using interfaces. 2. Write a Java program to handle multiple exceptions using try-catch-finally blocks. 3. Write a Java program to create a generic class with a type parameter and demonstrate storing different types of objects. 4. Write a Java program to sort an ArrayList of strings and integers using Collections.sort(). 5. Write a Java program to read data from a text file and display the content on the console. 6. Write a Java program to write user input data into a text file. 7. Write a Java program to create and run a thread by extending Thread class and by implementing Runnable interface. 8. Write a Java program to demonstrate inter-thread communication using wait() and notify(). 9. Write a Java program to build a simple GUI calculator using Swing components (JFrame, JButton, JTextField). 10. Write a Java program to demonstrate usage of lambda expressions to filter and print even numbers from a list. **Note:** Students will also perform all other exercises provided by course Instructor.	15	CO2

Suggested Readings

1. E.Balagurusamy, Programming with Java, Tata McGraw Hill.
2. Patrick Naughton and Herbertz Schildt,"Java2.0:The Complete Reference",TMH,1999.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105191/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2		3	3	2	3		2	3		3	3	3
CO2	3	3		3	3	2	3		3	3		3	3	3

Program	Master of Computer Applications (DS&AI)				
Year	I	**Semester**	I		
Course Name	Relational Database Management System Lab				
Code	MCADSN21152				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The main objective is students gain knowledge about databases for storing the data and to share the data among different kinds of users for their business operations				
Course Outcomes					
CO1	Develop database modeling for a problem and normalization.				
CO2	Design a database/query using PL/SQL.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Creating and Managing Tables a. Creating and Managing Tables b. including Constraints 2. Manipulating Data a. Using Insert statement. b. Using Delete statement. c. Using Update statement. 3. SQL Statements–1 a. Writing Basic SQL Select Statements b. Restricting and Sorting Data c. Single-Row Functions 4. SQL Statements–2 a. Displaying Data from Multiple Tables b. Aggregating Data Using Group Functions c. Subqueries 5. Using SET operators, Date/Time Functions, GROUPBY clause a. Using Set Operators b. Date time Functions c. Enhancements to the group By Clause d. Advanced Subqueries 6. Creating and Managing other database objects a. Creating Views b. Other Database Objects c. Controlling User Access 7. Using DCL commands a. creating users. b. Authenticating users c. Rollback command **Note:** Students will also perform all other exercises provided by course Instructor.	15	CO1
2	1. Creating and Operation on Sequenced 2. Creating and Performing operation on Index 3. Creating a Simple Program of PL/SQL 4. Creating and Using Stored Procedure through PL/SQL 5. Creating and Using Function through PL/SQL 6. Creating Implicit and Explicit Cursor Program 7. Creating Triggers and Firing it **Notes**: Students will also perform all other exercises provided by course instructor.	15	CO2

Suggested Readings

1. Ivan Bayross, “SQL, PL/SQL: The Programming Language of Oracle”, BPP Publication
2. Connolly & Begg, “Database Systems: A Practical Approach to Design, Implementation and Management” , Pearson Education.

Online Resources

1. https://www.youtube.com/watch?v=TB5T2O8Hwm8

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2			1	2	1	1		2		1	1	1	
CO2	1	1	1	1	2	2	2		2		1	2	1	1

SECOND SEMESTER

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	No SQL & MongoDB				
Code	MCADSN22101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	0	0	2
Course Objectives	Students will understand fundamental concepts of several different NOSQL products. Students will also learn various CRUD operations and the querying mechanisms in NOSQL. Students will also comprehend advanced topics. Use the MongoDB tools to develop and deploy your applications.				
Course Outcomes					
CO1	Define, compare, and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column-oriented and Graph).				
CO2	Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Definition of NOSQL, History of NOSQL and different NOSQL Products Interfacing Exploring Mongo DB java, Exploring Mongo DB Ruby/Python, Interfacing and Interacting with NOSQL Interacting with NOSQL	15	CO1
2	Data Model Design (Embedded Data Models and Normalized Data Models), Querying NOSQL stores, Modifying Data Stores and Managing Evolution MongoDB Use Cases, Understanding the NOSQL architecture, Understanding the, NOSQL architecture, Understanding the, NOSQL architecture, Performing CRUD, NOSQL in cloud, Parallel Processing with Map Reduce, Big Data with Hive Surveying Database, Migrating from RDBMS to NOSQL, Query for All Documents in a Collection, Query by a Top-Level Field	15	CO1

Suggested Readings

1. David Hows, "The definitive guide to mongoDB ", 2nd edition Publication, 2009, 8132230485
2. Shakuntala GuptaEdward, "Practical MongoDB", Second edition, Apress Publications, 2016, ISBN 1484206487

Online resources

1. https://cognitiveclass.ai/courses/data-science-methodology-2

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	2	2	1	1		2	2	1	2	2	1
CO2	2	2		2	2	2	2	2	3	2		2	3	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**		II	
Course Name	Descriptive Analytics				
Code	MCADSN22102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Understand how analytics provided a solution to industries using real case studies and learn the importance of analytics and how it is transforming the world today.				
Course Outcomes					
CO1	To understand and implement the concept of configuring and using IBM Cognitive Analytics Tool.				
CO2	Understand how a business analysis software works, and its architecture.				
CO3	Create different types of advanced reports.				
CO4	Learn to create gauge, pie charts and RAVE visualizations.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Changing business with data insight Overview:** Understand how analytics is transforming the world, Understand the profound impact of analytics in business decisions, understand what analytics is and how it works, understand why business analytics has become important in various industries, Understand the history of analytics and how it has changed today, Understand how to analyse unstructured data, Understand how analytics is making the world smarter, understand where the future of analytics lies, Explain why successful enterprises need business analytics, Understand how business analytics can help turn data into insight, Understand how predictive analytics. is transforming all types of organizations, explain how analytics supports retail companies, understand how analytics can reduce crime rates and accidents, Explain the use of analytics in law enforcement and insurance companies, understand how analytics can affect the future of education, Predictive Analytics Modeler, Big Data Developer, Data Warehouse Developer.	15	CO1
2	**IBM Cognos Analytics for Consumers:** Introduction to IBM Cognos Analytics Reporting What is IBM Cognos Analytics Reporting, Explore the environment, Examine the side panel, explore authoring templates, Generate the report, create list reports Examine list reports, Group data, Format list columns, include list headers and footers Focus reports using filters Create filters, Filter your data with advanced detail filters, Create crosstab reports Create a crosstab report, Add measures to crosstab reports, Data sources for crosstabs.	15	CO2

3	**Accessing the data warehouse and present data graphically:** Extend reports using calculations Derive additional information from the data source, add run-time information to your report, Add Date/Time functions to your report, Add string functions to your report. Information integration Components, Functions, Information integration, The challenges, Data workflow, Present data graphically Create a chart report, Different chart options, Create charts containing peer and nested items, Create and reuse custom chart palettes, Add data-driven baselines and markers to charts, Focus reports using prompts Examine parameters and prompts, Create a parameter item on the report, Build a prompt page, Add a prompt item to a report, Use additional report building techniques Enhance report design, Add objects, Organize objects using tables, Break a report into sections, Convert a list to a crosstab, Reuse objects within the same report.	15	CO3
4	**Wrap up and planning considerations and customize reports:** Wrap up and Planning considerations Summary and Planning Considerations, Data insight, The big picture, Bringing all together, Suggestions for success. Customize reports with conditional formatting Change displays based on conditions, 3 steps for conditional formatting, Step 1. Create a variable, Step 2. Assign the variable to a report object, Step 3. Apply formatting to object based on condition value. Drill- through definitions Let users navigate to related data in IBM Cognos Analytics, set up drill-through access from a report, Package-based drill through, Specify the values passed to target parameters, Steps to set up a package-based drill through definition, Limit the items that users can drill through from, Drill Through Assistant. Enhance report layout View the structure of the report, Force page breaks in reports, Horizontal pagination, Modify structures.	15	CO4

Suggested Readings

1. IBM Courseware.
2. Analytics: Business Intelligence, Algorithms and Statistical Analysis (Predictive Analytics, Data Visualization, Data Analytics, Business Analytics, Decision Analysis, Big Data, Statistical Analysis by Todd J Blatt
3. Learning Spark: Lightning-Fast Big Data Analysis by Holden Karau
4. Python for Everybody: Exploring Data in Python 3 by Dr. Charles Russell Severance Managing Your Business
5. The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts, And Figures

Online Resources

1. https://cognitiveclass.ai/courses/data-science-methodology-2

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	2	2	1	1		1	1	1	1	2	1
CO2	1	2		2		1	2	2	1	1		2	3	3
CO3	1	1		1	1	2	3	1	2	2	2	2	1	2
CO4	2	2		2	3	2	2	1	2	3	1	3	2	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Data Structures Using Java				
Code	MCADSN22103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course objective is to make the student learn fundamental data structures algorithms and implements various data structure operation algorithms on Array, stacks, Queue linked list, Tree and Graph.				
Course Outcomes					
CO1	To understand the basic concepts in data structure and Design and implement abstract data types such as linked list.				
CO2	To understand designing and Implementations of linear data structure like stack Queue by using java language.				
CO3	To understand the design and implementation of nonlinear data structure Tree and graph by using java language.				
CO4	To understand appropriate searching and sorting techniques java application development.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Data Structures:** Need, Importance, and Classification, Abstract Data Types (ADT), Algorithm Analysis: Time and Space Complexity, Big O Notation; **Arrays and Strings:** One-Dimensional and Multi-Dimensional Arrays, Operations: Insert, Delete, Search, Update, Strings in Java: String class, StringBuilder; **Linked Lists:** Singly Linked List: Creation, Insertion, Deletion, Traversal, Doubly Linked List, Circular Linked List.	15	CO1
2	**Stacks:** Concepts and Applications (e.g., undo, expression parsing), Implementation using Arrays and Linked Lists, Infix to Postfix, Postfix Evaluation; **Queues:** Simple Queue, Circular Queue, Deque, Priority Queue, Queue interface; **Recursion:** Basics and Use Cases, Recursion vs. Iteration, Stack Memory in Recursion (Factorial of a number, Fibonacci)	15	CO2
3	**Trees:** Definitions and Terminology, Binary Trees and Traversals (Recursive & Iterative), Binary Search Tree (BST): Insertion, Deletion, Searching, Balanced Trees: AVL Trees (Concept and Rotations); **Graphs:** Representation: Adjacency Matrix and List; Graph Traversal: BFS and DFS, Directed vs Undirected Graphs Applications: Path Finding, Topological Sort	15	CO3
4	**Searching Algorithms:** Linear Search, Binary Search (Iterative and Recursive); **Sorting Algorithms:** Bubble, Insertion, Selection, Merge Sort, Quick Sort; **Hashing:** Hash Tables, Hash Function.	15	CO4

Suggested Readings

1. "Java black book", Steve Holzner, Paraglyph Press.
2. "Data Structures Using Java", Duncan A Buell, Jones & Bartlett Learning.
3. "Data Structures and Algorithms in Java", Second Edition, Robert Laforel, SAMS.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs92/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1		2	2	3	1		1	2	1	3	3	3
CO2	3	2		3	2	3	1		1	2	1	3	3	3
CO3	3	2		3	2	3	1		1	2	1	3	3	3
CO4	3	2		3	2	3	1		1	2	1	3	3	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Web Technology & Application Development				
Code	MCADSN22104				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To focus on the process of Web Development. To build sound concepts of several languages used in Web Technology and create a dynamic, interactive website quickly, confidently, and successfully				
Course Outcomes					
CO1	Understand the basic concept of HTML , DHTML and CSS using Tailwind.				
CO2	Understanding the basic concept of Java Script and its application.				
CO3	Understanding the basic concept of PHP and its application.				
CO4	Student able to develop personal and professional websites using React.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**HTML:** Introduction to HTML5; Introduction to Text Formatting tags; **Types of Lists:** Ordered, Unordered, Definition lists; **Table tags:** Methods to Create Tables , Attributes of Table tag, colspan and rowspan; Block level and Inline elements; Classes; Entities; frameset tags and its Attributes; **Form tag:** Creation of Forms, Textbox, Radio Button, Hidden etc.; **DHTML**: Style Sheets, Need of CSS; **Types of Style Sheet:** Inline, Internal and External; position, display; **Tailwind:** Introduction, working with tailwind.	15	CO1
2	**JAVA SCRIPT:** Introduction, Basic Programming Techniques: Data Types, Constants, Variables, Array; Operators and Expressions; JavaScript Programming Constructs: Conditional statements, Loops; Functions in JavaScript: Built in Functions and User Defined Functions; Dialog Boxes; JavaScript DOM: Object hierarchy in DOM, Event Handling; Form Object: Form Object's Methods and properties, Text Element, Button Form, Form Validation etc.; Other Built in Objects: String, Math and Date; **Asynchronous programming:** Callbacks, Promises, Async/Await; Destructuring, Error Handling.	15	CO2
3	**Basics of PHP:** Introduction, Features , Data Types, Variables, Constants, Operators, Arrays; Conditional Statements and Iterations; **Functions in PHP:** User Defined and Built in Functions; String Functions; **Forms in PHP:** Adding elements to a form, uploading files to the web server; Debugging and Errors: Types of Errors and Error handling; Database Connectivity with MySQL.	15	CO3
4	**Introduction to React:** File structure of react project, Import and export, JSX Introduction, npm, Components, Virtual DOM, Props in React, Prop Drilling, Context API; **React Hooks:** Introduction, useState, useEffect, useRef, useContext; React DOM Events, Routing in react.	15	CO4

Suggested Reading

1. Burdman Jessica,"Collaborative Web Development", Addison Wesley. 2002.
2. Bayross Ivan,"HTML, DHTML. JavaScript, and PHP", BPB Publications, 4th Edition, 2001.
3. Xavier, C,"Web Technology and Design", New Age International, 2000.
4. Shah Dhruti "Node.JS Quickbook" BPB Publication. 2018.
5. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill.
6. James L Mohler and Jon Duff, "Designing interactive web sites", Delmar Thomson Learning.
7. Nicholas C. Zakas, Jeremy McPeak, Joe Fawcett, "Professional Ajax, 2nd Edition, Wrox.
8. Narang, Robin Wieruch, "The Road to React: Your journey to master plain yet pragmatic React.js", Leanpub. 2019.
9. Holmes, Shelley, "What is React?", O'Reilly Media. 2020.

Online Resources

1. https://onlinecourses.swayam2.ac.in/nou20_cs05/preview
2. React Tutorial | Geeks for Geeks

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	3	2	2		2	1	3	1	2	2
CO2	2		3		2	2	2	1	2		1	3	3	3
CO3		2	2	2	2	2	1		3		2	2	3	3
CO4	2		3		2	2	3		2	2	3	1	3	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Data Warehousing & Data Mining				
Code	MCADSN22105				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To understand the principles of Data warehousing and Data Mining and familiar with the Data warehouse architecture and its Implementation. Students also know the architecture of a Data Mining system, data pre-processing methods and Classification of the data for the prediction and analysis.				
Course Outcomes					
CO1	Understand the concepts and techniques used in Datawarehouse development and Deployment.				
CO2	Apply the exploratory analysis for data mining.				
CO3	Apply pattern analysis techniques.				
CO4	Design the models for classification and clustering using algorithms and Tools				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Data Warehousing:** Introduction of Data Warehousing, Types of Data Warehouse, General stages, Components, Architecture, Tools, Database vs Data Warehouse, Characteristics of Data Warehouse, Applications of Data Warehousing, Query Tools, Data Warehouse, Bus Architecture; ETL; Types of Data models, Advantages and Disadvantages of Data Model; **OLAP:** Introduction, Cube, Basic Analytical Operations, System types, Benefits of using OLAP services; ROLAP: Introduction, Architecture, Advantages, Tools; **MOLAP:** Introduction, Architecture, Advantages, Tools, OLTP vs. OLAP, Benefits of OLTP method; **Schemas:** Star and SnowFlake Schema in data warehousing, Multidimensional schemas, Galaxy schema, Star Cluster schema. **Data Mart:** Type of Data Mart, Steps in implementing a Data mart. **Data Lake: Architecture**, concepts, Maturity stages, Difference between Data lakes and Data Warehouse.	15	CO1
2	**Introduction to Data Mining:** Data Mining, Steps in Data Mining Major issues in data mining. Techniques of Data Mining - an overview of techniques and examples for each technique. **Preparing to Model the Data:** Supervised Versus Unsupervised Methods **Data Preprocessing:** Key steps in Data Preprocessing- Data Cleaning, Handling Missing Data, identifying misclassifications, Identifying Outliers; **Data Visualization:** Meaning and common techniques, Integrating various aspect of visualization with Data Mining like Exploratory Data Analysis, Clustering etc. Pictorial representation of Data Visualization; **Dimension-Reduction Methods:** Need for Dimension-Reduction in Data Mining, Principal Components Analysis, Profiling the Principal Components, Communalities, Validation of the Principal Components.	15	CO2

3	**Frequent Pattern Analysis:** Frequent pattern Data Mining: Frequent Itemset, Frequent Pattern, support, Confidence, Association Rules. Apriori Algorithm, FP tree, Frequent Pattern Base, Conditional FP Tree , FP growth with numerical examples for finding association rules in Frequent pattern Data Mining. Pattern Mining in Multilevel, Multidimensional Space, Application of Multilevel, Multidimensional Space Data Mining Constraint based Frequent Pattern Mining, Challenges and consideration, Recent advance in Constraint based Frequent Pattern Mining.	15	CO3
4	**Classification:** k-Nearest Neighbor Algorithm, Classification Task, k-Nearest Neighbor Algorithm, Distance Function, Decision Tree induction in Data Mining, Decision Tree working ID3 Algorithm, Decision Rules. Advantages and Disadvantages of decision tree; **Rule-Based Classification in Data Mining,** working of rule based classification, Advantages and Application; **Clustering:** Key objectives of clustering, *k*-Means Clustering, , *k*-Means Clustering Algorithm and its application. hierarchal clustering and its type **WEKA TOOLS :** Introduction to WEKA TOOLS The Explorer – Getting started, Exploring the explorer, Learning Algorithms, Clustering algorithms, Association–rule learners using WEKA.	15	CO4

Suggested Readings

1. Daniel T Larose, Chantel D.Larose,"Data Mining and Predictive analysis",Wiley2015.
2. Paul rajponniah "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals," Wiley, 2013
3. Jiawei Hanand Micheline Kamber,"Data Mining Concepts and Techniques" Elsevier.
4. Max Bramer, "Principles of Data Mining", Springer

Online Resources

1. "https://www.youtube.com/@datamining-iitkgp625",IIT Kharagpur,NPTEL2018

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	1	1	1	1				2	1	1	2
CO2	2	2	2	2	2								2	2
CO3	2	2	3	3	2	2							3	3
CO4	3	2	2	2	3	2							3	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Research Methodology				
Code	MCADSN22106				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	0	0	2
Course Objectives	The course aims to develop research aptitude skills among the learners and to enable them to prepare a research report. To identify the relevance and role of research and differentiating between different kinds of research available, data models, data handling and analysis.				
Course Outcomes					
CO1	To Understand the basic concepts of research and Outlining the significance of research and research methodology.				
CO2	To Formulate research process for solving the business related problems. To develop ability to determine qualitative and quantitative methods of collection of data and sampling. Able to prepare and present an effective research report.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Research Methodology:** Scope, Purpose, Need, Functions and Application of research; Types of research, Criteria of research; **Process of Research:** Steps of research process, Unit of Analysis- Individual, and organizational, Group and data series; Concept, Construct, Attributes, Variable and Hypotheses; **Research Design:** Various Methods of Research Design, Review of literature, Planning research, Preparing the Research Proposal, Elements of Research Proposal, Evaluating Research Proposal; Problem identification and formulation; Research design; Applications of Research	15	CO1
2	**Data Collection:** Primary and Secondary source of data, Qualitative vs Quantitative data, Methods of Data Collection; **Research Modelling:** Field study, laboratory study, survey method, observational method, existing data based research; Scaling techniques; **Report/ Thesis writing:** Pre writing consideration, Formulation of research projects/ proposals; Format of Report, Presentation of Research report, Research / review articles, bibliography norm & plagiarism.	15	CO2

Suggested Readings

1. Cooper, Donald R and Schindler, Business Research Methods, 9th Edition, Tata McGraw Hill.
2. Chawla, Deepak & Sondhi, Neena, Research Methodology- Concepts and Cases, Vikas Publication House.
3. Kothari C R, Research Methodology Methods &Techniques, 2nd Edition, New Age International Publishers.
4. Naresh Malhotra, Market Research, Pearson Education.
5. Kumar, Ranjit, Methodology: A Step by Step guide for Beginners, Pearson Education

Online References:

1. https://study.sagepub.com/onlineresearchmethods2e

2. https://laverne.libguides.com/c.php?g=34939&p=5114220

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	2	1	2	2	-	1	2	1	2	-	1
CO2	1	1	1	1	1	2	2	-	1	2	1	1	-	3
CO3	1	1	1	1	1	2	1	-	1	2	1	1	-	3
CO4	2	3	3	2	2	2	2	-	3	3	1	2	1	2

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**		II	
Course Name	Optimization Techniques				
Code	MCADSN22121				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course provides a holistic understanding of optimization, logistics, and project management & SPSS. Students will learn to solve different types of optimization problems, manage logistics efficiently, and plan projects effectively, preparing them for analytical roles in diverse industries.				
Course Outcomes					
CO1	To understand Master problem-solving techniques for linear programming and optimization.				
CO2	Develop skills to solve transportation and assignment problems efficiently.				
CO3	Apply inventory management principles effectively in real- World scenarios.				
CO4	Develop Skills to solve Job Sequencing problems and understand the concept of CPM & PERT				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Linear Programming Problem**: Introduction to LPP, Components of LPP, Formulation of LPP, Graphical Solution of LPP, Slack and Surplus Variable, Basic Feasible Solution, Unbounded Solution, Optimal Solution, Simplex Method, Artificial Variables, Two-Phase Method, Big-Method, Duality, Dual Simplex Method, Revised Simplex Method, Problem of Degeneracy.	15	CO1
2	**Transportation Problem:** Introduction, Basic Feasible Solution of TP, North-West Corner Method, Matrix Minima Method, Row Minima Method, Column Minima Method, Vogal's Approximation Method, Degeneracy in TP, Loops in TP, Optimal Solution, Unbalanced TP; **Assignment Problem:** Introduction and Application of AP, Hungarian Algorithm for AP, Unbalanced AP.	15	CO2
3	**Inventory Management:** Introduction, Types of Inventories, Costs Involved in Inventory Decisions, Economic Order Quantity (EOQ), Determination of EOQ, EOQ Model without Shortage and with Shortage, Inventory Model with Price-Break, Replacement Problem.	15	CO3
4	**Job Sequencing:** Introduction, N-Jobs Two Machines, N-Jobs Three Machines, N-Jobs M Machines; **CPM and PERT: i**ntroduction, Application of CPM/PERT, Network Diagram, Floats, Critical Path, Project Evaluation and Review Technique (PERT).	15	CO4

Suggested Readings

1. GilletB.E.,"IntroductiontoOperationResearch,ComputerOrientedAlgorithmicap proach", Tata McGraw Hill Publising Co. Ltd. New Delhi.
2. P.K. Gupta &D.S. Hira, "Operations Research", S. Chand &Co.
3. J.K. Sharma, "Operations Research: Theory and Applications", MacMillan.
4. S.D. Sharma, "Operations Research", Kedar Nath Ram Nath, Meerut(UP).

Online Resources

1. http://www.digimat.in/nptel/courses/video/111105039/L21.html
2. https://www.digimat.in/nptel/courses/video/111105077/L25.html

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	2	2	1			1	1		2	1	1
CO2	1	2	1	2	2	1			1	1		2	1	1
CO3	1	2	2	2	1	1	1		1	2		2	1	
CO4	2	2	2	3	2	1	1		1	2		2	1	1

Program	Master of Computer Applications (DS & AI)		
Year	I	**Semester**	II
Course Name	Cloud Computing		
Code	MCADSN22122		

Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4

Course Objectives	To provide skills and knowledge in cloud technology operations to implement large-scale systems and provide expertise for creating appropriate cloud infrastructure that fulfils the needs of business services and customers.
Course Outcomes	
CO1	To understand basic concepts, principles and paradigm of cloud computing and deployment model basics.
CO2	To examine existing cloud infrastructures and determine an acceptable architecture that fulfils business goals. To interpret various cloud computing models, services and also identify the significance of implementing virtualization techniques.
CO3	Interpret alternative service delivery and deployment methods to find a model that best fits the company's needs and apply the tools, techniques, and skills acquired to develop projects.
CO4	Identify cloud computing security and privacy risks and develop appropriate security.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Cloud Computing Basics:** Introduction, History, Need, Advantages and Disadvantages, Issues and Challenges; Cloud Characteristics: Elasticity, Resource Pooling, Scalability, On-demand Service s, Pay as per Usage Pricing; **Cloud Deployment Models:** Public, Private, Hybrid, Community; Impact of Cloud Computing: Business Perspective; Grid vs. Parallel Computing.	15	CO1
2	**Cloud Architecture**: Introduction, NIST Cloud Computing Reference Architecture; Cloud Service Models: Software as a Service, Platform as a Service, Infrastructure as a Service; **Virtualization:** Introduction, Need, Pros and Cons, Types of Virtualizations: Software, Memory, Storage, Server and Network; **Hardware Virtualization:** Introduction, Full, Partial and Para Virtualization, Hypervisor, Type 1 and Type 2.	15	CO2
3	**Cloud Service Providers:** Google Cloud-Introduction, Microsoft Azure-Core Concept, and Amazon Web Services (AWS)-Compute, Storage and Communication Services; **Cloud Applications:** Healthcare-ECG Analysis in the Cloud, Biology-Protein Structure Prediction and Gene Expression Data Analysis for Cancer Diagnosis, Geoscience-Satellite Image Processing, Social Networking.	15	CO3
4	**Overview of Cloud Security:** Cloud Security Fundamentals: Confidentiality, Integrity, Availability, Cloud Security Threat, Vulnerability, Risk; Security Governance, Security Standards; **Securing Data:** Encryption, Hashing, Digital Signature, Steganography, Cryptography, Authentication: 1FA, 2FA, MFA, Access Control and Security Mechanism.	15	CO4

Suggested Readings:

1. Rajkumar Buyya, Christian Vecchiola, S. T. Selvi, Mastering Cloud Computing", McGraw-Hill.
2. Barrie Sosinsky, "Cloud Computing Bible", Wiley India.
3. Nikos Antonopoulos, Lee Gillam, "Cloud Computing: Principles, Systems and Applications", Springer.
4. Ronald L. Krutz, Russell Dean Vines ,"Cloud Security: A Comprehensive Guide to Secure Cloud Computing",Wiley-India.

Online Resources:

1. https://nptel.ac.in/courses/106105167
2. https://onlinecourses.nptel.ac.in/noc22_cs20/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1				1		1		1	1		1
CO2	2	1	1	1	1		1		1	1	1	1	1	2
CO3	2	1	2	1	2	1	2		2	2	2	2	1	3
CO4	1	2	2	2	2	1	2		2	3	2	2	2	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**		II	
Course Name	Natural Language Processing				
Code	MCADSN22123				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Artificial Intelligence and Automata	3	1	0	4
Course Objectives	To understand the algorithms available for the processing of linguistic information and computational properties of natural languages. To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks. To familiarize various NLP software libraries and data sets publicly available. To develop systems for various NLP problems with moderate complexity. To learn various strategies for NLP system evaluation and error analysis.				
Course Outcomes					
CO1	Introduce the basic concepts of NLP, its applications, syntax, semantics, discourse & pragmatics of natural language.				
CO2	Demonstrate the understanding of Language Modeling and Neural Networks Basics.				
CO3	Discover the linguistic and statistical features relevance to the basic NLP task in context to parts-of-speech tagging.				
CO4	Understanding of parsing and semantic analysis.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to NLP**: NLP – introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of-speech and Formal Grammar of English.	15	CO1
2	**Language Modelling:** N-gram and Neural Language Models Language Modelling with N-gram, Simple N-gram models, smoothing (basic techniques), Evaluating language models; Neural Network basics, Training; Neural Language Model; **Case Study:** Application of neural language model in NLP system development.	15	CO2
3	**Parts-of-Speech Tagging:** Basic concepts; Tagset; **Early approaches:** Rule based and TBL; POS tagging using HMM, Introduction to POS Tagging using Neural Model.	15	CO3
4	**Parsing**: **Basic concepts:** top down and bottom-up parsing, treebank; **Syntactic parsing:** CKY parsing; **Statistical Parsing basics:** Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs; **Semantics**: Vector Semantics; Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis; **Embeddings from prediction:** Skip-gram and CBOW; Concept of Word Sense; Introduction to WordNet.	15	CO4

Suggested Readings:

1. Jurafsky D. and Martin J. H., “Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Upper Saddle River, NJ: Prentice-Hall.
2. Yoav G., “A Primer on Neural Network Models for Natural Language Processing”, AI Access Foundation
3. Vajjala S., Gupta A. and Surana H., “Practical Natural Language Processing”, O’Reilly.

Online Resources

1. https://elearn.nptel.ac.in/shop/nptel/applied-natural-language-processing/?v=c86ee0d9d7ed
2. https://www.coursera.org/learn/machine-learning-and-nlp-basics

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	2		1			2	2	2
CO2	2		2		2	2	2		1			2	2	1
CO3	2	2	2	2	3	2	3		2	2	2	2	2	2
CO4	2	2	3	2	2	2	3		3	2	2	2	3	3

Program	Master of Computer Applications (D S& AI)				
Year	I	**Semester**	II		
Course Name	Internet of Things (IoT)				
Code	MCADSN22124				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Assess the vision and introduction of IoT. Understand IoT Market perspective. Implement Data and Knowledge Management and use of Devices in IoT Technology. Classify Real World IoT Design Constraints, Industrial Automation in IoT.				
Course Outcomes					
CO1	Understand the basics of Embedded System, IoT and the development model.				
CO2	Understand the architecture, Instruction set and work on an 8-bit microcontroller using simulation and real-time.				
CO3	Ability to select appropriate hardware and microcontrollers based on need of application, Understand the Internet of Things Standards, Frameworks, and techniques.				
CO4	Apply the tools, techniques and skills acquired towards development of Projects.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Internet of Things (IoT), Design Principles for Connected Devices: Introduction to IoT, Basics of Networking, Communication Protocols, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, Sensor Networks, Machine-to-Machine Communications, IoT Examples, IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation.	15	CO1
2	**Technologies Standard and Hardware:** Introduction, Sensors, digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology, Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex	15	CO1 & CO2
3	Network & Communication Aspects in IoT, Case Studies, **Cloud Computing:** Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring. Introduction of Cloud Computing.	15	CO3
4	Challenges in IoT Design Challenges, **IoT Applications:** Development challenges, Security challenges, Other 15 Hours 1 challenges, Smart metering, e-health, Smart city, automotive applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart streetlights in smart city.	15	CO4

Suggested Readings

1. Embedded Real Time Systems: Concepts, Design and Programming by Dr.K.V.K.K. Prasad, DreamTech Publication, 2003.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, Pearson Education, 2011.
3. by Adrian McEwen, Hakim Cassimally, Wiley Publications, 2012.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs65/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1		1	1	1		1		1	1	2	1
CO2	1	2	1		2	2	1		2		1	1	2	2
CO3	2	2	2	2	2	2	2		2	2	2	3	2	3
CO4	1	2	2	2	2	2	2		2	2	1	3	2	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Data Structure Using Java Lab				
Code	MCADSN22151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To understand Java Programming language and various concepts of Data Structures, Their usage and implement them using 'Java' programming language.				
Course Outcomes					
CO1	Design and implement abstract data types such as linked list, stack, and queue using Java as the programming language.				
CO2	Design and implement tree, graph by using Java as the programming language.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1.	1. Implementation of Arrays (Single & Double Dimension). Implementation of String. 2. Implementation of Recursive Procedure(Factorial, Fibonacci) 3. Implementation of Stack, Queue, Circular Queue using array. 4. Implementation of infix to postfix and infix to prefix conversion using stack. **Note:** Students will also perform all other exercises provided by course Instructor.	15	CO1
2	1. Implementation of Tree Traversals (preorder, inorder, postorder). 2. Implementation of B-Tree. 3. Implementation of AVL Tree. 4. Implementation of Searching techniques: Linear Search, Binary Search. 5. Implementation of Sorting techniques: Bubble sort, Merge sort, Insertion sort, Selection sort, and Quick sort. 6. Implementation of graph traversal (BFS, DFS). **Notes**: Students will also perform all other exercises provided by course instructor.	15	CO2

Suggested Readings

1. "Data Structures Using Java", Duncan A Buell, Jones & Bartlett Learning.
2. "Data Structures and Algorithms in Java", Robert Lafore, SAMS.

Online Resources

1. https://python-iitk.vlabs.ac.in/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1		1		1	1		3	1	1	2	2	3
CO2	2	2		3	2	3	2		3	2	2	3	2	3

Program	Master of Computer Applications (DS & AI)				
Year	I	**Semester**	II		
Course Name	Web Technology & Application Development Lab				
Code	MCADSN22152				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To focus on the process of Web Development. To build sound concepts of several languages used in Web Technology and create a dynamic, interactive website quickly, confidently, and successfully.				
Course Outcomes					
CO1	Gradually build a static website using HTML, DHTML and CSS. Move this skill upward by creating some degree of user interactivity using JavaScript.				
CO2	Server-side data processing by creating PHP scripts technologies using react framework.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Implementation of List Tags in HTML. 2. Implementation of Table Tag in HTML. 3. Implementation of Frameset Tag in HTML. 4. Implementation of different Form Tags in HTML. 5. Implementation of CSS in Web Pages. 6. Implementation of Tailwind classes in Web Pages. 7. Implementation of control structure in Java Script. 8. Implementation of Looping structure in Java Script 9. Implementation of Asynchronous programming in Java Script. **Note:** Students will also perform all other exercises provided by course Instructor.	15	CO1
2	1. Installation, configuration and working with XAMPP Web Server. 2. Implementation of PHP tags, variables, and conditional construct. 3. Implementation of looping structure in PHP 4. Implementation of functions in PHP 5. Implementation of string functions in PHP 6. Implementation of database connectivity using MySQL. 7. Writing simple applications with Technologies like HTML, CSS, JavaScript, PHP. 8. Building website using React framework. **Notes**: Students will also perform all other exercises provided by course instructor. **Note:** Students will also perform all other exercises provided by course Instructor.	15	CO1

Suggested Readings :

1. Burdman Jessica, Web Addison Wesley. 2002.
2. Bayross DHTML. JavaScript, and BPB Publications, 4th Edition, 2001.
3. Xavier, Technology and New Age International, 2000.
4. Shah Dhruti BPB Publication. 2018.
5. Achyut S Godbole and Atul Kahate, Tata McGraw Hill.
6. James L Mohler and Jon Duff, interactive web Delmar Thomson
7. Learning. Nicholas C. Zakas, Jeremy McPeak, Joe Fawcett, Ajax, 2nd Wrox.
8. Narang, Robin Wieruch, "The Road to React: Your journey to master plain yet pragmatic React.js", Leanpub. 2019.

Online Resources

1. https://html-iitd.vlabs.ac.in/
2. https://www.cybrary.it/practice-lab/introduction-to-programming-using-java-script
3. Holmes, Shelley, "What is React?", O'Reilly Media. 2020.

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	2	1		1	1		3	1	1	3	3	3
CO2	2	2	3	3	2	3	2		3	2	3	3	3	3

THIRD SEMESTER

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Big Data Analytics and Architecture				
Code	MCADSN23201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To provide an overview of an exciting growing field of big data analytics. To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. To explain the importance of Bigdata, spark. To strengthen the understanding of basic concepts of spark and scala. To prepare sample project in hadoop. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming Capability. To enable students to have skills that will help them to solve complex real-world problems in for decision support.				
Course Outcomes					
CO1	To develop an understanding of the complete open-source Hadoop ecosystem and its near-term future direction				
CO2	To understand the Map Reduce model v1 and review java code				
CO3	Learn to do Mining of Bigdata				
CO4	Learn to Process of Data streams.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Describe the complete open-source Hadoop ecosystem and its near-term future directions, Describe the major challenges of data, Explain how the growth of interconnected devices contributes bigdata, List real-life examples of BigData, List the types of Big Data, Identify Big Data use cases, Describe the evolution from traditional data processing to big data processing Hadoop and HDFS, Loading data with Sqoop, Import and export data from MySQL to hive	15	CO1
2	Describe the functions and features of HDP, List the IBM added value components. Describe the purpose and benefits of each added value component), Describe the MapReduceProgrammingmodel,DescribeHadoopv1andMapReduce v1 and list their limitations, Describe Apache Hadoop v2 and YARN, Compare Hadoop v2 and YARN with Hadoop v1.	15	CO2
3	Lambda Architecture in Big Data; Batch processing and speed processing in Lambda architecture Mining Bigdata DataStreams and analysis of timeseries; Recommender systems; Social network analysis	15	CO3
4	Introduction to Scala and Spark; Analytics using Spark SQL; introduction to all spark libraries with their working (Spark coreSpark MLlibs park Graphx Spark streaming and Spark SQL), Apache Storm, Components of Spark Unified stack, RDD,Word count using scala, Introduction to queuing systems. Eg. Kafka, Introduction to Data storage and processing; Defining Hadoop Cluster Requirements; Maximizing HDFS Robustness; Managing Resources and cluster Health; Maintaining a cluster; Implementing Data Ingress and Egress.	15	CO4

Suggested Readings

1. Shankar maniwiley, , Wiley.
2. IBM material.
3. Alex Holmes, in , Manning Publications.

Online Resources

1. https://archive.nptel.ac.in/courses/106/104/106104189/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	1	2	1	1	1	1	1	1	2	1	1	1
CO2	2	2		2	2	2	2		2	2	2	3	2	3
CO3	2	2	1	3	2	2	2		2	3	3	2	2	2
CO4	2	3		2	3	3	2		2	3	3	2	2	3

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Artificial Intelligence				
Code	MCADSN23202				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Describe the field of AI and its subfields machine learning, NLP and computer vision Describe the types of AI List the factors that influenced the advancements of AI in recent years. List applications of AI. Explain what Machine Learning is. Describe the types of machine learning: Supervised learning, unsupervised learning, and deep learning. Explain neural networks. Explain what NLP is and list its applications. Explain what computer vision is and list its applications				
Course Outcomes					
CO1	To understand the basics of AI				
CO2	To learn how to work with Watson services				
CO3	To learn about NLP and NLC				
CO4	To understand basics of chatbots and computer vision				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Artificial Intelligence Overview:** AI impact in the world today, History and evolution of AI, AI Technologies, Eras of Computing, types & main focus of AI, ML & its types, Neural Networks, NLP & processes, Use Cases, Computer Vision tools and use cases, Cognitive Computing, Setting up of IBM Bluemix Account, AI Trends, Limits of Machine and Human, AI predictions in next 5 years.	15	CO1
2	**Artificial Intelligence Foundation:** AI industry adoption approaches: AI Industry impact, autonomous Vehicles, Smart robotics, future work force and AI, IBM Watson and real-world problems, Deep QA Architecture, Commercialization of Watson, Watson Services capabilities of each Watson service, Watson Knowledge Studio, Usage of Watson API explorer.	15	CO2
3	**NLP and NLC:** NLP- Processes, Tools and services of NLP, NLP Use cases, Different components of NLP, Challenges with NLU, NLP Pipeline. Capabilities of IBM Watson NLC, NLU and its capabilities, Watson Tone Analyzer, Watson Discovery Service, Using Discovery API, UIMA Pipeline utilized in Watson jeopardy, virtual agent for enterprise.	15	CO3
4	**Chatbots**: Chatbot and its applications, growing popularity of chatbots, tools and services for chatbots, Workspace, Intentity & dialog nodes. Nodes in a dialog, Advanced features of a chatbot, Creation of Watson Assistant Instance, add intents and test in slack. **Computer Vision**: AI vision through deep learning, CV history and advancement with AI, CU Use cases, Pipeline within a CV application, Feature Extraction, image classification and recognition, IBM Visual Recognition Service, Image classification and object detection, face recognition and image preprocessing using OpenCV python library.	15	CO4

Suggested Readings

1. Elaine A Rich, "ArtificialIntelligence", Tata McGraw-Hill Publishing Company Limited.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", Shroff Publishers & Distributors Pvt. Ltd

Online Resources

1. https://nptel.ac.in/courses/106105077

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	1	2	1	1	1		1	1	2	1	1	1
CO2	2	2		2	2	2	2		2	2	2	3	2	3
CO3	2	2	1	3	2	2	2		2	3	3	2	2	2
CO4	2	3		2	3	3	2		2	3	3	2	2	3

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	R Programming for Data Science				
Code	MCADSN23203				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective is to provide fundamental understanding of R Programming/RStudio. Also able to understand needs and usages of graphical tools and statistical functions, correlations, and other R Programming related aspects				
Course Outcomes					
CO1	Able to understand R Programming/RStudio, commands, conditional and Iterative statements.				
CO2	Able to identify and manage data Structures, Utilizing inbuilt functions and custom functions using R Programming				
CO3	Able to identify and manage and implementation of Data management and data frames, reading and writing data in files.				
CO4	Able to understand the implementation of statistical functions, handling data with graphical tools.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Fundamentals of R Programming:** Fundamentals of R Programming, installation and use of Base-R/RStudio software, data editing, and use of R as a calculator, Writing R scripts in an editor, Vector and scalar, missing data and logical operators, Conditional executions and iterative statements /Loops.	15	CO1
2	**Data Structures and Functions:** Data management with sequences. Data management with repeats, sorting, ordering, and lists, Vector indexing, factors, Data management with strings, display and formatting, inbuilt function support, creating custom functions.	15	CO2
3	**Matrices and Data Frames:** Creating matrices and Data frames, Matrices and dataframe functions, slicing data frame, combining slicing with functions, data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames. Advanced Data frames manipulations, import of external data in various file formats.	15	CO3
4	**Plots and Statistical function:** Graphics and plots, Colors, plotting arguments, Scatterplot, Histogram, Barplot, pirateplot, Low level plotting functions, Saving plot to pdf, jpg, png file formats, statistical functions (linear and nonlinear modeling, classical statistical tests, time-series analysis, classification, clustering) for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations,	15	CO4

	Data persistency, Hypothesis test (T Test, Correlations Test, Chi Square Test).		

Suggested Readings

1. Christian Heumann, Michael Schomaker and Shalabh "Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R" Springer.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet "The R Software- Fundamentals of Programming and Statistical Analysis" Springer.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters "A Beginner's Guide to R (Use R)" Springer.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://home.iitk.ac.in/~shalab/sprs.htm

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					1		1						
CO2	2	1				1		1		1				
CO3	2	2		1	1	2		2		1		1		
CO4	2	2		1	1	2		2		1		1	1	

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Simulation % Modeling				
Code	MCADSN23204				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre- Requisite		2	0	0	2
Course Objectives	The primary objective of this course is to provide students with a comprehensive understanding of simulation techniques used for modeling complex systems. The course aims to equip students with the knowledge and skills required to analyze real- world systems using discrete-event simulation and system dynamics.				
Course Outcomes:					
CO1	To equip students with the fundamental principles and techniques for developing and implementing simulation models for analyzing the behavior of complex systems.				
CO2	Able to implement the model and from the results check for the correctness of the assumptions.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations of Modeling and Simulation: Introduction to Modeling:** The concept of a model, different types of models (deterministic vs. stochastic, static vs. dynamic); Importance of abstraction and idealization; **System Dynamics Modeling (Introduction):** Concepts of feedback loops, rates, and levels, Simple examples of system dynamics models; **Stochastic Processes in Simulation:** Introduction to random processes, Poisson process and its applications in modeling, Markov chains (basic concepts and examples); **Queuing Theory Fundamentals:** Characteristics of queuing systems, Kendall's notation. Basic queuing models (M/M/1). Application of queuing models in computer systems and networks.	15	CO1
2	**Random Number and Random Variate Generation:** Properties of good random numbers, Generation of pseudo-random numbers (Linear Congruential Generators - basic idea), Inverse transform technique for random variate generation; **Discrete-Event Simulation Implementation:** Manual simulation using event scheduling, Introduction to simulation software (e.g., a brief overview of features and capabilities of Arena, SimPy, or similar);	15	CO2

Suggested Reading:

1. Narsingh Deo, “System Simulation with digital computer”, PHI.
2. Averill M. Law and W. David Kelton, “Simulation Modeling and Analysis”, TMH.

Online Resources:

1. https://archive.nptel.ac.in/courses/112/107/112107214

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	3	3	3			2	2		1	2	2
CO2	2	3	2	3	3	2			1	2		2	2	2

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**		III	
Course Name	Deep Learning				
Code	MCADSN23221				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine learning fundamental, Linear Algebra, Probability, and Numerical Computation are all needed preliminaries.	3	1	0	4
Course Objectives	The subject provides the fundamental concepts of Deep Learning and its applications in various fields and it also covers the fundamentals of linear algebra, neural networks, including sigmoid neurons, multi-layered perceptron, recurrent neural networks, convolutional neural networks, encoder/decoders, and attention networks, as well as the training procedures for these neural networks and their applications.				
Course Outcomes					
CO1	Learn the fundamentals of deep learning models and how to apply them.				
CO2	Understand the architecture of various neural networks and how to train them.				
CO3	Recognize the distinction between sigmoid neurons and CNN.				
CO4	Know the foundation of sophisticated neural network like encoder/decoder and attention network.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Deep Learning**: Basic concept of deep learning and its applications, Historical Trends in Deep learning; Revisiting of Neural Network; **Convolutional Neural Network:** Convolution and its type, Layers of CNN and its working, Advance CNN architecture: LeNet, Alexnet, VGGNet, GoogleNet, ResNet, Train network for image classification, Semantic Segmentation, Hyperparameter optimization, Transfer learning; Application of CNN.	15	CO1
2	**Recurrent Neural Network**: Introduction, Architecture, Deep RNNs, Bi-RNN; **Algorithm to train the RNN**: Backpropagation through time, Truncated Backpropagation Through Time, Challenges in training the RNN, Vanishing gradient **Types of RNN**: LSTM, Gated RNN; **Application of RNN:** Case Study: Sequence classification or any other similar case study.	15	CO2
3	**Encoder/Decoder**: Introduction, Architecture, Application: A case study on image captioning or sentiment analysis, or translation; **Pre-Trained Models**: Self-Supervised Pretraining, AlexNet, VGG, NiN, GoogleNet, Residual Network (ResNet), DenseNet, Region-Based CNNs (R-CNNs), Transfer Learning, FSL.	15	CO3
4	**Attention Network and Transformers**: Introduction, Attention mechanism, Types of Attention, Architecture, Attention Pooling, Scoring Functions, Self-Attention and Positional Encoding; Bidirectional Encoder Representations from Transformers (BERT), Generative Pre-trained Transformers.	15	CO4

Suggested Readings

1. Goodfellow, Benjio Corivilli, “Deep Learning”, Mit Press.
2. Bishop, “Pattern Recognition and Machine Learning”, Springer.
3. Chollet, “Deep Learning with Python”, Manning Publications.
4. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc19_cs54/preview
2. https://archive.nptel.ac.in/courses/106/106/106106184/
3. https://dl4cv-nptel.github.io/DL4CVBK/intro.html

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1			1			2	1	1
CO2	2		2		2	2			1			2	1	1
CO3	2	2	2	2	3	2	1		2	2	2	2	2	2

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Pattern Recognition				
Code	MCADSN23222				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To understand basic, as well as advanced techniques of pattern classification Statistical, nonparametric and neural network techniques for pattern recognition have been discussed. Finding and understanding patterns is crucial to mathematical thinking and problem solving				
Course Outcomes					
CO1	To understand the analyze pattern recognition and statistical pattern recognition and apply it to various domains.				
CO2	To understand, analyze and apply parameter estimation methods in different problem domains.				
CO3	To study and analyze various models for knowledge representation.				
CO4	To understand the basic concepts of machine learning to analyze and implement Neural network concepts.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction**: Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches; Classification and Clustering, Statistical **Pattern Recognition**: Bayesian Decision Theory, Classifiers, and Normal density, Discriminant functions.	15	CO1
2	**Nonparametric Techniques**: Density Estimation, Parzen Windows, K- Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification; **Parameter estimation methods**: Maximum-Likelihood estimation, Bayesian Parameter estimation, Expectation maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.	15	CO2
3	**Linear Discriminant Functions**: Gradient descent procedures, Perceptron, Support vector machines a brief introduction; **Dimensionality reduction**: Principal component analysis, Fisher discriminant analysis, Eigen vectors/Singular vectors as dictionaries, Factor Analysis, Dictionary learning method, Total variability space and non-negative matrix factorization;	15	CO3
4	**Artificial neural networks**: Multilayer Perceptron, Feed Forward neural network, A brief introduction to deep neural networks, Convolution neural networks, recurrent neural networks, **Non-metric methods for pattern classification**: Non numeric data or nominal data, **Decision trees**: Classification and Regression Trees(CART).	15	CO4

Suggested Readings

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, John Wiley.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer.
3. S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, Academic Press.
4. EarlGose, Richard Johnson baugh, Steve, "Pattern Recognition and Image Analysis", Pearson.

Online Resources

1. https://nptel.ac.in/courses/117105101
2. https://archive.nptel.ac.in/courses/117/105/117105101/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1			1			2	1	1
CO2	2		2		2	2			1			2	1	1
CO3	2	2	2	2	3	2	1		2	2	2	2	2	2
CO4	2	2	3	2	2	2	1		3	2	2	2	3	3

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**	III		
Course Name	Neural Network				
Code	MCSDSN23223				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Introduce the fundamental concepts of Neural Network. Equip students with the learning process of ANN, RNN and CNN. Students will get the basic understanding of neural network fundamentals.				
Course Outcomes					
CO1	To understand how human brain works and how ANN mimics that.				
CO2	To understand ANN architecture and perceptron.				
CO3	To understand RNN, RNN types, architecture and LSTM.				
CO4	To understand CNN, CNN architecture, its layers and learning.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Biological Neural Network:** Structure and Working, Artificial Neural Networks applications, Fundamentals, Characteristics, History of Neural Networks, terminology; Topology of neural network architecture, Multilayer Neural Networks. Concept of Learning, Types of Learning, Learning Rules; Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Widrow-Hoff Learning Rule, Winner-Takes All Learning Rule, Error Correction and Gradient Descent.	15	CO1
2	**Artificial Neural Networks (ANN):** Artificial Neuron and its models, McCulloch-Pitts model, Perceptron, Single Layer Perceptron, Multi-Layer Perceptron, Adaline model; Neural Network, Architectures, Single Layer Feedforward Network, Multilayer Feedforward Network, Recurrent Networks, Various Activation Functions;	15	CO2
3	**Recurrent Neural Network (RNN):** Introduction to RNN, RNN v/s Feed Forward Neural Network, Types of RNN, Recurrent Neural Network Architecture, Back Propagation Through Time (BPTT); Applications of RNN in real world; Introduction to Long Short-Term Memory (LSTM) LSTM Architecture, Forget gate, input gate, output gate, LSTM vs RNN; Text Classification;	15	CO3
4	**Convolution Neural Network (CNN):** Introduction to CNN, Why Use CNN, CNN architecture, Working of Convolutional Layers, Layers of CNN, Merits of CNN, Demerits of CNN, Applications of CNN; Image Classification using CNN, Semantic Segmentation, Hype-parameter tuning; Transfer Learning; Popular CNN Architectures: LeNet, AlexNet, VGGNet, GoogleNet, ResNet.	15	CO4

Suggested Readings:

1. B. Yagnarayana, “Articial Neural Networks”, Prentice Hall of India.
2. S Rajsekaran & G.A. Vijaylakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice Hall of India.
3. Siman Haykin, “Neural Networks”, Prentice Hall of India.

Online Resources:

1. https://archive.nptel.ac.in//coureses//117/105/117105084

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	1		1			2	1	1
CO2	2				2	2			1				1	1
CO3	2	2		2	1	2	1			2	2		1	2
CO4	2	2	3	2	2	2				2	2		1	3

Program	Master of Computer Applications (Data Science & Artificial Intelligence)				
Year	II	**Semester**	III		
Course Name	R Programming for Data Science Lab				
Code	MCADSN23251				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The objective of this course is to provide students with a practical understanding of R Programming/RStudio. It will dive deep in managing the concept and significance of Data Management and Data Frames, and to understand need and usages of graphical tools and relevant statistical functions, correlations.				
Course Outcomes					
CO1	Able to work on RStudio and learn basics of R Programming, control & iterative, matrix, list, vector manipulations, inbuilt and custom Functions				
CO2	Able to Use data management through excel file, CSV File, Graphical tools and statistical functions.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Introduction to R and RStudio, Working with commands and variables 2. Implementation of various Data Structures in R (Vectors, Matrices, lists, data frames) 3. Implementation of various Control Structure (If-else statements, loops) 4. Implementations and usage of various inbuilt functions, writing custom functions and apply family functions in R Programming 5. Performing data manipulation with dplyr and tidyr packages 6. Performing Data visualization with ggplot2 for creating plots, scatter plots, histogram, box plots, customizing plots with themes, colors and labels 7. Introduction to Statistical Analysis in R Programming, Implementation of basic regression analysis. 8. Implementations of various inferential statistics (T-tests, ANOVA, Correlation) 9. Implementation of importing and exporting data to and from sources (CSV, Excel, database etc) 10. Introductions and demonstrate the use of readr and readxl packages. **Note:** Students will also perform all other exercises provided by course Instructor.	15	CO1
2	1. Creating and managing R Packages 2. Introduction to Probability and its implementation in R Programming 3. Simulation and Implementation of the Normal Curve using R Programming 4. Simulating and implementation of Measures of Central Tendency and Dispersion 5. Simulating and implementation Standard Deviations, Standard Scores and the Normal	15	CO2

	Distribution. 6. Simulating and implementation Hypothesis Testing: Testing the Significance of the Difference Between Two Means 7. Simulating and implementation Hypothesis testing: One and Two-tailed Tests 8. Simulating and implementation Bivariate Statistics for Nominal Data 9. Simulating and implementation Bivariate Statistics for Ordinal Data 10. Simulating and implementation Bivariate Statistics for Interval / Ratio Data. **Note:** Students will also perform all other exercises provided by course Instructor.		

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Suggested Readings

1. Christian Heumann, Michael Schomaker and Shalabh "Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R" Springer.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet "The R Software-Fundamentals of Programming and Statistical Analysis" Springer.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters "A Beginner's Guide to R (Use R)" Springer.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://home.iitk.ac.in/shalab/sprs.htm

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					1		1						
CO2	2	1				1		1		1				

FOURTH SEMESTER

Program	Master of Computer Applications (DS & AI)				
Year	II	**Semester**	IV		
Course Name	Machine Learning				
Code	MCADSN24201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		4	0	0	4
Course Objectives	To introduce students to the basic concepts and techniques of Machine Learning. To develop skills of using recent machine learning software for solving practical problems. To gain experience of doing independent study and Research. Ability to identify the characteristics of data sets and compare the trivial data and big data for various applications				
Course Outcomes					
CO1	Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.				
CO2	Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.				
CO3	Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.				
CO4	Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to machine learning**: Application of Machine Learning, Supervised vs Unsupervised Learning, Python libraries suitable for Machine Learning; PYTHON for MACHIN E LEARNING: Intro to NumPy, Join NumPy Arrays, NumPy Intersection & Difference, NumPy Array Mathematics, Saving and Loading NumPy Array; Introduction to pandas, Pandas Series Object, Pandas Data Frame Object, Pandas Functions; Data visualization using Matplotlib and Seaborn library: bar graph, line graph, histogram, pie chart, scatter graph; Data Pre- processing and Data Scaling Methods: Identifying and handling the missing values, Encoding the categorical data, Normalization, Standardization.	15	CO1
2	**Data pre-processing and data:** Identifying and handling the missing values using fillna() function and Simple Imputer library of sklearn Encoding the categorical data, Normalization, Standardization, PCA.	15	CO2
3	**Supervised learning regression and classification**: Regression Algorithms: Linear Regression, Decision Tree Regressor, Random Forest Regressor, SVR: Support Vector Regressor, Time Series Problem; Model evaluation methods: mean absolute error, square mean error, RMS Evalue; Classification Algorithms: Logistic Regression, tree classifier, Random Forest classifier, SVM, Naïve bayes Decision: Gaussian NB, Multinomial **NB Bernoulli's** NB; Model evaluation methods: accuracy score, Precision, recall, F1-score	15	CO3

4	**Unsupervised Learning: Clustering Algorithm:** K-means Clustering (Elbow and purpose method), Hierarchical Clustering; **Dimension Reduction:** PCA; **Feature Scaling:** Minmax Scaler, Standard Scaler	15	CO4

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	3	3			1	2		2	2	2
CO2	2	2	3	2	3	2			1	3		2	1	2
CO3	2	2	1	2	2	2			1	2		2	1	1
CO4	2			2	2	1				2		1	2	2

Suggested Readings

1. TomM. Mitchell , "MachineLearning", McGraw Hill Education
2. Sebastian, Raschkaand Vahid Mirjalili, "Python Machine Learning",Packt Publishing.
3. Aurélien Géron Hands -On Machine Learning with Scikit-Learn and TensorFlow:Concepts, Tools, and Techniqueto Build Intelligent Systems", O'Reilly Media
4. Shai Shalev-Shwartz and ShaiBen, David , AI Understanding Machine Learning , Cambridge University Press

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106139/