


**ACADEMIC YEAR(2022-2023)**

S.No	Name of the course	Course Code	Programme Offering	Project work	Internip training	Number of students
1	Project Work	MC5414	MASTER OF COMPUTER APPLICATIONS	✓		3
2	Python Programming	MC5107	MASTER OF COMPUTER APPLICATIONS	✓		1
3	Advanced Database Technology	MC5105	MASTER OF COMPUTER APPLICATIONS		✓	3
4	Artificial Intelligence and Machine Learning	MC5208	MASTER OF COMPUTER APPLICATIONS	✓		1
5	Data Science	MC5306	MASTER OF COMPUTER APPLICATIONS		✓	1
6	Internet Programming	MC5206	MASTER OF COMPUTER APPLICATIONS	✓		3
7	Cloud Computing Technologies	MC5207	MASTER OF COMPUTER APPLICATIONS	✓		2

  
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**OBJECTIVES:**

- To learn the fundamentals of data modeling and design in advanced databases.
- To study the working principles of distributed databases.
- To have an introductory knowledge about the query processing in object-based databases and its usage.
- To understand the basics of spatial,temporal and mobile databases and their applications.
- To learn emerging databases such as XML,Datawarehouse and NoSQL.

**UNIT I      DISTRIBUTED DATABASES      9**

Distributed Systems–Introduction–Architecture–Distributed Database Concepts–Distributed Data Storage–Distributed Transactions–Commit Protocols–Concurrency Control–Distributed Query Processing

**UNIT II      NOSQL DATABASES      9**

NoSQL– CAP Theorem – Sharding- Document based– MongoDB Operation: Insert,Update, Delete, Query, Indexing, Application, Replication, Sharding, Deployment – UsingMongoDB with PHP / JAVA – Advanced MongoDB Features – Cassandra: Data Model, KeySpace, Table Operations, CRUD Operations, CQL Types – HIVE: Data types, DatabaseOperations,Partitioning–HiveQL–OrientDBGraphdatabase–OrientDBFeatures

**UNITIII      ADVANCED DATABASE SYSTEMS      9**

Object Oriented Databases-Need for Complex DataTypes-The Object-Oriented DataModel-Object-Oriented Languages-Spatial Databases:Spatial DataTypes,Spatial Relationships, Spatial Data Structures, Spatial Access Methods– Temporal Databases:Overview – Active Databases – Deductive Databases – Recursive Queries in SQL – Mobile Databases: Location and Handoff Management, Mobile Transaction Models, Concurrency –Transaction Commit Protocols–Multimedia Databases.

**UNITIV      XMLANDDATAWAREHOUSE      9**

XML Database: XML – XML Schema – XML DOM and SAX Parsers – XSL – XSLT – XPath and XQuery – Data Warehouse: Introduction – Multidimensional Data Modeling – Star and Snowflake Schema–Architecture–OLAP Operations and Queries.

**UNITV      INFORMATIONRETRIEVALANDWEBSEARCH      9**

IR concepts – Retrieval Models – Queries in IR system – Text Preprocessing – Inverted Indexing – Evaluation Measures – Web Search and Analytics – Ontology based Search – Current trends.


## OUTCOMES:

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

- Design a distributed database system and execute distributed queries.
- Use NoSQL database systems and manipulate the data associated with it.
- Design a data warehouse system and apply OLAP operations.
- Design XML database systems and validating with XML schema.
- Apply knowledge of information retrieval concepts on web databases.

## REFERENCES:

- Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", 6<sup>th</sup> Edition, McGraw Hill, 2011.
- R. Elmasri, S. B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education/Addison Wesley, 2017.
- C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
- Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann, 2012.
- Brad Dayley, "Teach Yourself NoSQL with MongoDB in 24 Hours", Sams Publishing, First Edition, 2014.
- Shashank Tiwari, "Professional NoSQL", O'Reilly Media, First Edition, 2011.
- Vijay Kumar, "Mobile Database Systems", John Wiley & Sons, First Edition, 2006

  
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**OBJECTIVES:**

- To understand the basic concepts of Distributed systems
- To learn about the current trend and basics of Cloud computing
- To be familiar with various Cloud concepts
- To expose with the Server, Network and storage virtualization
- To be aware of Micro services and DevOps

**UNIT I DISTRIBUTED SYSTEMS 9**

Introduction to Distributed Systems – Characterization of Distributed Systems – Distributed Architectural Models – Remote Invocation – Request-Reply Protocols – Remote Procedure Call – Remote Method Invocation – Group Communication – Coordination in Group Communication – Ordered Multicast – Time Ordering – Physical Clock Synchronization – Logical Time and Logical Clocks

**UNIT II INTRODUCTION TO CLOUD COMPUTING 9**

Cloud Computing Basics – Desired features of Cloud Computing – Elasticity in Cloud – On demand provisioning - Applications – Benefits – Cloud Components: Clients, Datacenters & Distributed Servers – Characterization of Distributed Systems – Distributed Architectural Models – Principles of Parallel and Distributed computing – Applications of Cloud computing – Benefits – Cloud services – Open source Cloud Software: Eucalyptus, Open Nebula, Openstack, Aneka, Cloudsim.

**UNIT III CLOUD INFRASTRUCTURE 9**

Cloud Architecture and Design – Architectural design challenges – Technologies for Network based system - NIST Cloud computing Reference Architecture – Public, Private and Hybrid clouds – Cloud Models: IaaS, PaaS and SaaS – Cloud storage providers - Enabling Technologies for the Internet of Things – Innovative Applications of the Internet of Things.

**UNIT IV CLOUD ENABLING TECHNOLOGIES 9**

Service Oriented Architecture – Web Services – Basics of Virtualization – Emulation – Types of Virtualization – Implementation levels of Virtualization – Virtualization structures – Tools & Mechanisms – Virtualization of CPU, Memory & I/O Devices – Desktop Virtualization – Server Virtualization – Google App Engine – Amazon AWS – Federation in the Cloud.

**UNIT V MICRO SERVICES AND DEVOPS 9**

Defining Micro services – Emergence of Micro service Architecture – Design patterns of Micro services – The Mini web service architecture – Micro service dependency tree – Challenges with Micro services - SOA vs Micro service – Micro service and API – Deploying and maintaining Micro services – Reason for having DevOps – Overview of DevOps – History of DevOps – Concepts and terminology in DevOps – Core elements of DevOps – Lifecycle of DevOps – Adoption of DevOps – DevOps Tools – Build, Promotion and Deployment in DevOps – DevOps in Business Enterprises.

**OUTCOMES:**

Upon completion of the course the students will be able to

- Use Distributed systems in Cloud Environment
- Articulate the main concepts, key technologies, strengths and limitations of Cloud computing
- Identify the Architecture, Infrastructure and delivery models of Cloud computing
- Install, choose and use the appropriate current technology for the implementation of Cloud
- Adopt Micro services and DevOps in Cloud environment

**REFERENCES:**

1. Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, First Edition, 2012
2. Andrew S. Tanenbaum & Maarten Van Steen, "Distributed Systems - Principles and Paradigms", Second Edition, Pearson Prentice Hall, 2006
3. Thomas Erl, Zaigham Mahood & Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall, Second Edition, 2013
4. Richard Rodger, "The Tao of Microservices", ISBN 9781617293146, Manning Publications, First Edition, December 2017.
5. Magnus Larsson, "Hands-On Micro services with Spring Boot and Spring Cloud: Build and deploy micro services using spring cloud, Istio and kubernetes", Packt Publishing Ltd, First Edition, September 2019.
6. Jim Lewis, "DEVOPS: A complete beginner's guide to DevOps best practices", ISBN-13: 978-1673259148, ISBN-10: 1673259146, First Edition, 2019.



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**COURSE OBJECTIVES:**

- To understand the fundamentals of web programming and client side scripting.
- To learn the server side development using servlets, websocket.
- To learn the Spring framework and build applications using Spring.
- To learn and implement the concept of Java Persistence API.
- To learn the advanced client side scripting and framework.

**UNIT I INTRODUCTION TO WEB&CLIENT SIDE PROGRAMMING 9**

Introduction to Web: Server - Client - Communication Protocol (HTTP), JavaScript: Data Types and Variables - Expressions - Operators and Statements - Objects and Arrays - Functions-Classes-Modules-DOM-Events-Storage :Local Storage, Cookies, Indexed DB,JSON,AJAX

**UNIT II SERVER SIDE PROGRAMMING 9**

Web Server: Web Containers - Web Components, Servlet: Lifecycle - Request – Servlet Context - Response - Filter - Session - Dispatching Requests, Web Socket, Logging - Log4j2,Buildtool-Gradle.Introduction to Spring:IoC Container and Dependency Injection(DI)

**UNIT III SPRING 9**

Spring Configuration and Spring Boot, Spring MVC: Dispatcher Servlet and Configuration - Interceptors - Controllers - Views - Input Validation - File Upload, Building RESTfull Web Services, Spring Security Architecture, Spring Cache.


**UNIT IV JAVA PERSISTENCE API AND HIBERNATE 9**

Entity : Basic,Embeddable and Collection Types-Identifiers-Entity Relationship-Inheritance, Persistence Context and Entity Manager, JPQL, Criteria API, Spring Data JPA –Specification and Projection.

**UNIT V ADVANCED CLIENT SIDE PROGRAMMING 9**

Asynchronous JavaScript: Callbacks - Promises - async and await, React JS: React DOM - JSX-Components-Properties-State and Life cycle-Events-Lifting State Up-Composition and Inheritance-Higher Order Components.

**TOTAL: 45 PERIODS**

  
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**Course Outcomes:**

Upon completion of the course the students should be able to:

- To write client side scripting.
- To implement the server side of the web application.
- To implement Web Application using Spring.
- To implement a Java application using Java Persistence API.
- To implement a full-stack Single Page Application using React, Spring and JPA.

**REFERENCE BOOKS:**

- David Flanagan, "Java Script: The Definitive Guide", O'Reilly Media, Inc, 7th Edition, 2020
- Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN: 978-1-119-36656-0, 2019
- Alex Banks, Eve Porcello, "Learning React", O'Reilly Media, Inc, 2nd Edition, 2020  
<https://reactjs.org/docs>
- David R. Heffelfinger, "Java EE 8 Application Development", Packt Publishing, First edition 2017
- Benjamin Muschko, "Gradle in Action", Manning Publications, First edition 2014
- Iuliana Cosmina, Rob Harrop, Chris Schaefer, Clarence Ho, "Pro Spring 5: An In-Depth Guide to the Spring Framework and Its Tools", Apress, Fifth edition 2017
- Christian Bauer, Gavin King, and Gary Gregory, "Java Persistence with Hibernate", Manning Publications, \r, 2nd Edition, 2015

  
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**OBJECTIVES:**

- To familiarize with the principles of Artificial intelligence like problem solving, inference, perception, knowledge representation, and learning.
- To understand the various characteristics of Intelligent agents
- To design and implement the machine learning techniques for real world problems
- To gain experience in doing research using Artificial intelligence and Machine learning techniques.

**UNIT I ARTIFICIAL INTELLIGENCE**

9

Foundation of AI-History of AI-State of Art.-Intelligent Agents: Agents and Environments- Concepts of Rationality-Nature of Environments-Structure of Agents. Problem Solving: Problem Solving by Search: Problem Solving Agents-Searching for Solutions-Uniform Search Strategies-Heuristic Search Strategies- local Search Algorithms and Optimization Problems.

**UNIT II KNOWLEDGE AND REASONING**

9

Logical Agents: Knowledge Based Agents-Logic-Propositional Logic-Propositional Theorem Proving-Model Checking-Agent based on Propositional Logic. First-Order Logic: Syntax and Semantics- Using First-Order Logic-Knowledge Engineering. Inference in First-Order Logic:Prepositional Vs. First-Order Inference-Unification and Lifting-Forward Chaining-Backward Chaining -Resolution.

**UNIT III BAYESIAN LEARNING**

9

Basic Probability Notation- Inference – Independence - Bayes' Rule. Bayesian Learning: Maximum Likelihood and Least Squared error hypothesis-Maximum Likelihood hypotheses for predicting probabilities- Minimum description Length principle -Bayes optimal classifier - Naïve Bayes classifier - Bayesian Belief networks - EM algorithm.

**UNIT IV PARAMETRIC MACHINE LEARNING**

9

Logistic Regression: Classification and representation – Cost function – Gradient descent – Advanced optimization – Regularization - Solving the problems on over fitting. Perceptron – Neural Networks – Multi – class Classification – Back propagation – Non-linearity with activation functions (Tanh, Sigmoid, Relu, PRelu) - Dropout as regularization.

k- Nearest Neighbors- Decision Trees – Branching – Greedy Algorithm - Multiple Branches – Continuous attributes – Pruning. Random Forests:ensemble learning. Boosting – Adaboost algorithm. Support Vector Machines – Large Margin Intuition – Loss Function - Hinge Loss – SVM Kernels.


**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Apply the techniques of Problem Solving in Artificial Intelligence.
- Implement Knowledge and Reasoning for real world problems.
- Model the various Learning features of Artificial Intelligence
- Analyze the working model and features of Decision tree
- Apply k-nearest algorithm for appropriate research problem.

**REFERENCES:**

- Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach” , ThirdEdition Pearson Education Limited, 2015
- CalumChace , “Surviving AI: The Promise and Peril of Artificial Intelligence”, Three CSpublication, Second Edition, 2015.
- Christopher M Bishop, “Pattern Recognition and Machine Learning”, Spring 2011 Edition.
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning: Data Mining, Inference and Prediction”, Springer 2<sup>nd</sup> Edition
- EthemAlpaydin, "Introduction to Machine Learning", Second Edition, MIT Press, 2010.
- Tom M. Mitchell, “Machine Learning”, India Edition, 1<sup>st</sup> Edition, McGraw-Hill EducationPrivate Limited, 2013
- Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition,Tata McGraw-Hill Education, 2012

  
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**OBJECTIVES:**

- To know the fundamental concepts of data science and analytics.
- To learn fundamental data analysis using R.
- To understand various data modeling techniques.
- To learn the basic and advanced features of open source big data tools and frameworks.
- To study various analytics on stream data.

**UNIT I INTRODUCTION TO DATA SCIENCE AND BIG DATA 9**

Introduction to Data Science – Data Science Process – Exploratory Data analysis – Big data: Definition, Risks of Big Data, Structure of Big Data – Web Data: The Original Big Data – Evolution Of Analytic Scalability – Analytic Processes and Tools – Analysis versus Reporting Core Analytics versus Advanced Analytics– Modern Data Analytic Tools – Statistical Concepts: Sampling Distributions – Re-Sampling – Statistical Inference – Introduction to Data Visualization.

**UNIT II DATA ANALYSIS USING R 9**

Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis – Bivariate Analysis: Correlation – Regression Modeling: Linear and Logistic Regression – Multivariate Analysis – Graphical representation of Univariate, Bivariate and Multivariate Analysis in R: Bar Plot, Histogram, Box Plot, Line Plot, ScatterPlot, Lattice Plot, Regression Line, Two-Way cross Tabulation.

**UNIT III DATA MODELING 9**

Bayesian Modeling – Support Vector and Kernel Methods – Neuro – Fuzzy Modeling – Principal Component Analysis – Introduction to NoSQL: CAP Theorem, MongoDB: RDBMS Vs MongoDB, Mongo DB Database Model, Data Types and Sharding – Data Modeling in HBase: Defining Schema – CRUD Operations

**UNIT IV DATA ANALYTICAL FRAMEWORKS 10**

Introduction to Hadoop: Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Introduction to MapReduce – Running Algorithms Using MapReduce – Introduction to HBase: HBase Architecture, HLog and HFile, Data Replication – Introduction to Hive, Spark and Apache Sqoop.

## UNIT V STREAM ANALYTICS

8

Introduction To Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window.

**TOTAL: 45 PERIODS**

### OUTCOMES:

- On completion of the course, the students will be able to:
- Convert real world problems to hypothesis and perform statistical testing.
- Perform data analysis using R.
- Design efficient modeling of very large data and work with big data platforms..
- Implement suitable data analysis for stream data.
- Write efficient Map Reduce programs for small problem solving methods.

### REFERENCES:

- Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, First Edition, 2013.
- Umesh R Hodeghatta, UmeshaNayak, “Business Analytics Using R – A Practical Approach”, Apress, First Edition, 2017.
- J. Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014.
- NishantGarg, “HBase Essentials”, Packt, First Edition, 2014.
- Rachel Schutt, Cathy O'Neil, “Doing Data Science”, O'Reilly, First Edition, 2013
- Foster Provost, Tom Fawcet, “Data Science for Business”, O'Reilly, First Edition, 2013.
- Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley, First Edition, 2014.
- <https://www3.cs.stonybrook.edu/~skiena/519/>



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