SRI VENKATESWARA COLLEGE OF ENGINEERING,

(An Autonomous Institution, Affiliated to Anna University, Chennai – 600025)

M.E., Computer Science and Engineering

CURRICULUM AND SYLLABUS

REGULATIONS – 2022

CHOICE BASED CREDIT SYSTEM

Curriculum Revision No:		Board of Studies recommendation date :	08.10.2022	Academic Council Approved date:	14.11.2022
Salient Points of the revision	01.	To provide evolving domain specific skills and technologies.			
	02.	To equip with the holistic knowledge of the subjects.			
	03.	To be the driving force of the IT industry.			
	04.	To develop professionals who can contribute for the need and growth of the society.			
	05.	To advance the field in the core areas through the production of new software, algorithms and models through their research publications.			

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REGULATIONS 2022

M.E. COMPUTER SCIENCE AND ENGINEERING

CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONALOBJECTIVES (PEOs)

Computer Science and Engineering program will prepare its learners:

I. To understand the foundational and advanced concepts in Computer Science and Engineering to excel in research by adapting to the rapid advances in new emerging technologies.
II. To critically analyze the emerging trends and technologies and future issues at multiple levels and propose research oriented solutions.
III. To effectively communicate technical information, function effectively on teams.
IV. To provide innovative solutions to real-world problems of society by following ethical practices.
V. To pursue lifelong multidisciplinary learning as professional engineers and scientists.

PROGRAM OUTCOMES (POs)

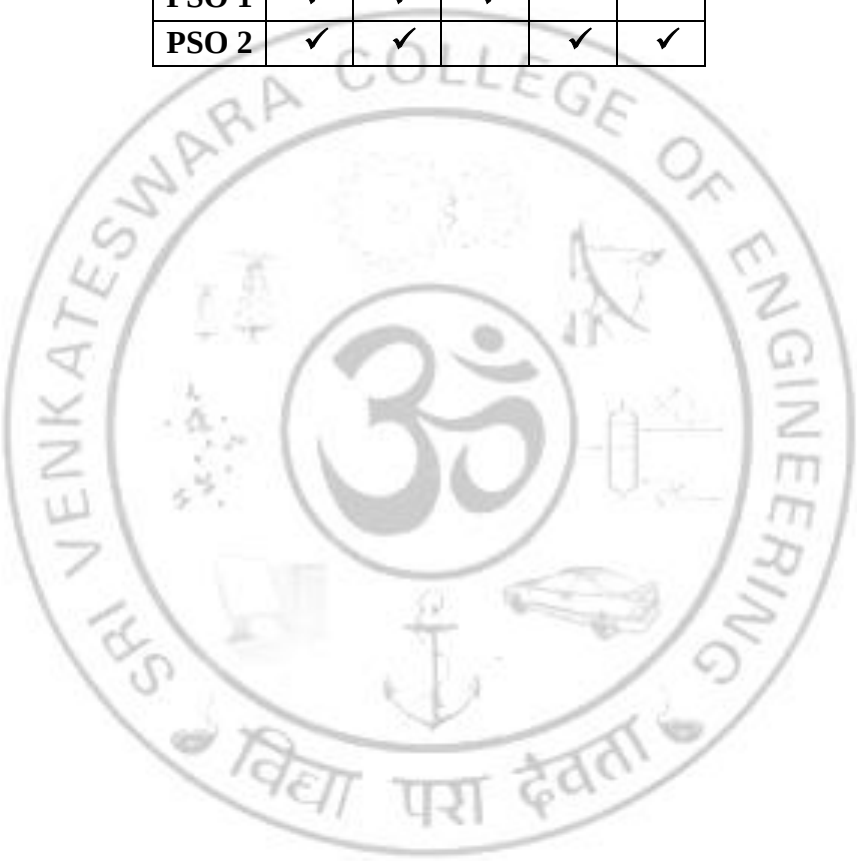
1. An ability to independently carry out research / investigations, identify problems and develop solutions to solve practical problems.
2. An ability to write and present a substantial technical report/ document.
3. Students should be able to demonstrate a degree of mastery in the field of Computer Science and Engineering.
4. Use research based knowledge, methods, appropriate techniques, resources and tools to solve complex engineering issues with an understanding of the limitations.
5. An ability to function effectively by applying technical knowledge, ethical practices as an individual and a team member in the career.
6. Recognize the need for independent, life-long learning and engage in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Graduates will gain advance-level competency and skills in core and emerging technologies of Computer Science and Engineering.
2. Graduates will develop viable solutions to real-world problems through continuous learning and research skills.

PEO's – PO's & PSO's MAPPING:

POs	PEOs				
	I	II	III	IV	V
PO1	✓	✓		✓	
PO2		✓	✓	✓	✓
PO3	✓	✓	✓	✓	✓
PO4	✓			✓	✓
PO5		✓		✓	✓
PO6	✓			✓	✓
PSO 1	✓	✓	✓		
PSO 2	✓	✓		✓	✓



SRI VENKATESWARA COLLEGE OF ENGINEERING,

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REGULATIONS 2022

CHOICEBASEDCREDITSYSTEM

M.E. COMPUTER SCIENCE AND ENGINEERING

CURRICULUM FOR SEMESTERS I TO IVAND
SYLLABI FOR SEMESTERS I TO IV

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY#	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITE	POSITION
				L	T	P	C			
Theory Subjects										
1.	MA22184	Linear Algebra and Statistics	PC	3	1	0	4	4	-	F
2.	CP22101	Advanced Data Structures and Algorithms	PC	3	0	0	3	3	-	F
3.	CP22102	Machine Learning	PC	3	0	0	3	3	-	F
4.	CP22103	Database Concepts	PC	3	0	0	3	3	-	F
5.	CP22104	Advanced Software Engineering	PC	3	0	0	3	3	-	F
6.	CP22105	Foundations of Data Science	PC	3	0	0	3	3	-	F
Practical Subjects										
7.	CP22111	Advanced Data Structures and Algorithms Laboratory	PC	0	0	4	2	4	-	F
8.	CP22112	Machine Learning Laboratory	PC	0	0	4	2	4	-	F
			Total	**18**	**1**	**8**	**23**	**27**	**-**	**-**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY#	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITE	POSITION
				L	T	P	C			
Theory Subjects										
1.	CP22201	Cloud Services and Virtualization	PC	3	0	0	3	3	-	F
2.	CP22202	Cyber Security Techniques	PC	3	0	0	3	3	-	F
3.	CP22203	Internet of Things	PC	3	0	0	3	3	-	F
4.	CP22204	Big Data Analytics	PC	3	0	0	3	3	-	F
5.	****	Professional Elective - I	PE	3	0	0	3	3	-	M
6.	****	Professional Elective - II	PE	3	0	0	3	3	-	M
7.	GR22251	Introduction to Research Methodology and IPR (Common to all branches)	MC	3	0	0	3	3	-	F
Practical Subjects										
8.	CP22211	Data Analytics Laboratory	PC	0	0	4	2	4	-	F
9.	CP22212	Industrial Visit and Technical Seminar	PC	0	0	2	1	2	-	F
			Total	**21**	**0**	**6**	**24**	**27**	**-**	**-**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY#	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITE	POSITION
				L	T	P	C			
Theory Subjects										
1.	CP22309	Advanced Neural Networks	PC	3	0	2	4	4	-	F
2.	****	Professional Elective - III	PE	3	0	0	3	3	-	M
3.	****	Professional Elective - IV	PE	3	0	0	3	3	-	M
Practical Subjects										
4.	CP22311	Project Work – Phase I	EE	0	0	12	6	12	-	F
			TOTAL	9	0	14	16	22	-	-

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY#	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITE	POSITION
				L	T	P	C			
Practical Subjects										
1.	CP22411	Project Work – Phase II	EE	0	0	24	12	24	-	F
			TOTAL	0	0	24	12	24	-	-

Professional Elective - I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY#	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITE	POSITION
				L	T	P	C			
Theory Subjects										
1.	CP22002	Product Design and Development	PE	3	0	0	3	3	-	M
2.	CP22004	Agile Methodologies	PE	3	0	0	3	3	-	M
3.	CP22006	Quantum Computing	PE	3	0	0	3	3	-	M
4.	CP22008	Social Network Analysis	PE	3	0	0	3	3	-	M
5.	CP22010	Advanced Algorithms	PE	3	0	0	3	3	-	M

Professional Elective - II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY#	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITE	POSITION
				L	T	P	C			
Theory Subjects										
1.	CP22012	Recommender Systems	PE	3	0	0	3	3	-	M
2.	CP22014	Information Retrieval Techniques	PE	3	0	0	3	3	-	M
3.	CP22016	Natural Language Processing	PE	3	0	0	3	3	-	M
4.	CP22018	Visualization Techniques	PE	3	0	0	3	3	-	M
5.	CP22020	Deep Learning	PE	3	0	0	3	3	-	M

Professional Elective – III & IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY#	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITE	POSITION
				L	T	P	C			
Theory Subjects										
1.	CP22001	Web Engineering	PE	3	0	0	3	3	-	M
2.	CP22003	Full Stack Web Application Development	PE	3	0	0	3	3	-	M
3.	CP22005	Bitcoin and Blockchain technology	PE	3	0	0	3	3	-	M
4.	CP22007	Software Architectures and Design	PE	3	0	0	3	3	-	M
5.	CP22009	Language Technologies	PE	3	0	0	3	3	-	M
6.	CP22011	Web Analytics	PE	3	0	0	3	3	-	M
7.	CP22013	Next Generation Networks	PE	3	0	0	3	3	-	M
8.	CP22015	Devops and Microservices	PE	3	0	0	3	3	-	M

The Course category may be any one of the following:

i) Humanities and Social Sciences (HS)

ii) Management Courses (MG)

iii) Basic Sciences (BS)

iv) Engineering Sciences (ES)

v) Professional Core (PC)

vi) Professional Elective (PE)

vii) Open Elective (OE)

viii) Employability Enhancement (EE)

ix) Value Added (VA)

x) General Elective (GE)

xi) Mandatory Course (MC)

xii) Audit Course (AC)

MA22184 LINEAR ALGEBRA AND STATISTICS

L	T	P	C
3	1	0	4

OBJECTIVES

- Develop the ability to use the concepts of Linear Algebra for solving problems related to Machine Learning.
- Acquire knowledge of statistical principles in topics such as Correlation coefficient.
- Acquire knowledge of statistical methods in topic such as Estimation theory.
- Select the appropriate statistical procedure and apply relevant statistical tests depending on the data provided.
- Understand the concepts of multivariate normal distribution and principal components analysis components analysis.

PREREQUISITE: Basic concepts of Probability – Random Variables – Normal distribution (Not for Examination)

UNIT I LINEAR ALGEBRA **12**

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY **12**

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESIS **12**

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-square and F distributions.

UNIT V MULTIVARIATE ANALYSIS **12**

Random Vectors and Matrices - Mean vectors and Covariance matrices – Multivariate Normal density and its properties - Principal Components - Population principal components - Principal components from standardized variables.

TOTAL (L:45 + T:15): 60 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	To apply the concepts of Linear Algebra to solve practical problems.	**4**
CO2	To use the ideas of probability and random variables in solving engineering problems.	**2**
CO3	To be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.	**1**
CO4	To use statistical tests in testing hypotheses on data.	**2**
CO5	To develop critical thinking based on empirical evidence and the scientific approach to knowledge development.	**5**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES

1. Dallas E Johnson, "Applied multivariate methods for data Analysis", Thomson and Duxbury press, Singapore, 1998.
2. Richard A. Johnson and Dean W. Wichern, "Applied multivariate statistical Analysis", Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
3. Bronson, R.,"Matrix Operation" Schaum's outline series, Tata McGraw Hill, New York, 2011.
4. Oliver C. Ibe, "Fundamentals of Applied probability and Random Processes", Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson India Education, Asia, 9th Edition, New Delhi, 2017.

CP22101 **ADVANCED DATASTRUCTURES AND ALGORITHMS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn the hierarchical data structures with its operations
- To understand the working of graphs and its applications.
- To understand the dynamic programming and greedy algorithms.
- To study about NP Completeness of problems.

UNIT I ALGORITHMS FOR COMPUTING **9**

Algorithms: Algorithms as a Technology- Analyzing Algorithms - Designing Algorithms- Growth of Functions: Asymptotic Notation - Standard Notations and Common Functions- Recurrences: The Substitution Method - The Recursion-Tree Method.

UNIT II HIERARCHICAL DATA STRUCTURES **9**

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion-Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of Btrees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: Structure – Mergeable-Heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III GRAPHS REPRESENTATION TECHNIQUES **9**

Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim - Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm, Prims; AllPairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm.

UNIT IV DYNAMIC PROGRAMMING **9**

Dynamic Programming: Matrix- Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

UNIT V NP COMPLE AND NP HARD **9**

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	To enable the students appraise the usage of algorithms and understand the Hierarchical Data Structures	**4**
CO2	To enable the students appraise the usage of Graph Data Structures	**4**
CO3	To enable the students to apply various algorithmic design techniques	**3**
CO4	To categorize the NP completeness of the problems	**4**
CO5	Apply suitable design strategy for problem solving	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, ALGORITHMS, Fourth Edition, Pearson Education.

REFERCENCES:

1. S.Sridhar, “Design and Analysis of Algorithms”,First Edition, Oxford University Press, 2014.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice-Hall, 2011.
3. Steven S. Skiena, “The Algorithm Design Manual”, Springer, 2008.
4. Rajeev Motwani and PrabhakarRaghavan, “Randomized Algorithms”, Cambridge University Press, 1995.
5. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, “The Design and Analysis of Computer Algorithms”, Addison-Wesley, 1975.

CP22102 **MACHINE LEARNING**

L	T	P	C
3	0	0	3

OBJECTIVES

The Student should be made to:

- Understand the principles and concepts of machine learning.
- Learn various linear and probabilistic models.
- Gain knowledge on supervised learning models.
- Provide insights in unsupervised and ensemble models.
- Get introduced to graphical models and advanced learning techniques.

UNIT I MATHEMATICAL PRELIMINARIES AND INTRODUCTION TO MACHINE LEARNING **9**

Machine Learning – Basic Concepts in Machine Learning – Types of Machine Learning – Basics of Learning Theory – Concept Learning - Hypothesis space - Heuristics space search - Find – S algorithm - Version spaces - Induction Biases - Bias-Variance Tradeoffs - Modelling in Machine learning - Learning Frameworks - PAC Framework – Vapnik - Chervonenkis Dimension.

UNIT II LINEAR AND PROBABILISTIC MODELS **9**

Linear models for regression - Maximum Likelihood Estimation (MLS) - least squares - regularized least squares - The Bias-Variance Decomposition - Bayesian Linear Regression - Linear models for classification - Discriminant functions - Fisher's linear discriminant - Probabilistic generative models - Probabilistic discriminative models - Bayesian logistic regression - Bayesian learning - Maximum Aposterior (MAP) Estimation.

UNIT III SUPERVISED LEARNING **9**

Classification models - Naïve Bayes Classifier - Decision trees - Entropy computation using GINI - Information Gain - Support Vector Machines - Linear and Non-linear kernels - K-Nearest Neighbor model - Perceptron - Backpropogation Algorithm - Multilayer Perceptron - Classification and Regression Tree.

UNIT IV UNSUPERVISED LEARNING AND ENSEMBLE MODELS **9**

Clustering– K-means – Hierarchical Clustering – EM – Mixtures of Gaussians – Model Selection for Latent Variable Models – Evaluation of Clustering methods – Ensemble Methods: Bagging - Boosting - Gradient boosting.

UNIT V GRAPHICAL MODELS AND ADVANCED LEARNING TECHNIQUES **9**

Graphical models - Markov random fields - Hidden Markov Models - Representation - Learning - Decoding - Inference in graphical models - Monte Carlo models - Sampling - Reinforcement Learning -

Model Based - Model Free - Q learning - Introduction to Deep learning - Introduction to Evolutionary Computing.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to understand the mathematical relationship within machine learning algorithms.	**2**
CO2	Students will be able to solve the real time problems with the linear and probabilistic models.	**3**
CO3	Students will be able to develop solutions to classification problems.	**3**
CO4	Students will be able to apply unsupervised learning approaches and ensemble models to various applications.	**3**
CO5	Students will be able to explain the advancements in machine learning.	**2**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, “Mathematics for Machine Learning”, Cambridge University Press, First Edition, 2020.
2. Ethem Alpaydin, “Introduction to Machine Learning”, Fourth Edition, Prentice-Hall of India, 2020.
3. Peter Flach, “Machine Learning”, First Edition, Cambridge University Press, 2012.
4. Tom Mitchell, “Machine Learning”, First Edition, McGraw Hill, 1997.
5. Kevin P. Murphy. “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
6. Ameet V Joshi, “Machine Learning and Artificial Intelligence”, Springer, 2020.

CP22103 **DATABASE CONCEPTS**

L	T	P	C
3	0	0	3

OBJECTIVES

The Student should be made to:

- Describe the fundamental elements of relational database management systems and explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system.
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases.
- Understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT I RELATIONAL DATA MODEL **9**

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

UNIT II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY **9**

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

UNIT III XML DATABASES **9**

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery.

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS **9**

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.

UNIT V DATABASE SECURITY **9**

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.	**2**
CO2	Students will be able to Understand and write well-formed XML documents.	**3**
CO3	Students will be able to apply methods and techniques for distributed query processing.	**3**
CO4	Students will be able to design and implement secure database systems.	**3**
CO5	Students will be able to use the data control, definition, and manipulation languages of the NoSQL databases.	**2**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education 2016.

2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2019.

3. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.

4. Raghu Ramakrishnan , Johannes Gehrke “Database Management Systems”, Fourth Edition, McGraw Hill Education, 2015.

5. Harrison, Guy, “Next Generation Databases, NoSQL and Big Data” , First Edition, Apress publishers, 2015.

6. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Sixth Edition, Pearson Education, 2015.

CP22104 ADVANCED SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To have a clear understanding of Software Engineering concepts.
- To gain knowledge of the Analysis and System Design concepts.
- To learn how to manage change during development.
- To learn the SOA and AOP concepts.

UNIT I INTRODUCTION **9**

System Concepts – Software Engineering Concepts - Software Life Cycle –Introduction to Agile - Scrum-XP - Development Activities – Managing Software Development – Unified Modeling Language – Project Organization – Communication – Case Study – Applications using UML.

UNIT II ANALYSIS **9**

Requirements Elicitation – Understanding Requirements – Requirement Types - Use Cases – Unified Modeling Language, Tools – Analysis Object Model (Domain Model) – Analysis Dynamic Models – Non-functional requirements – Analysis Patterns.

UNIT III SYSTEM DESIGN **9**

Overview of System Design – Decomposing the system – System Design Concepts –System Design Activities – Addressing Design Goals – Managing System Design - Object Design Concept – Web Application Design – Aesthetic, Content and Architecture designs.

UNIT IV IMPLEMENTATION AND MANAGING CHANGE **9**

Programming languages and coding - Human computer interaction - Reusing Pattern Solutions – Specifying Interfaces – Mapping Models to Code – Testing - Rationale Management – Configuration Management – Project Management – Maintenance - Forward and Reverse Engineering.

UNIT V ASPECT ORIENTED SOFTWARE DEVELOPMENT **9**

AO Design Principles - Separations of Concerns, Subject Oriented Decomposition, Traits, Aspect Oriented Decomposition, Theme Approach, Designing Base and Crosscutting Themes, Aspect-Oriented Programming using Aspect-J. Terminology in Aspect-oriented programming.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to understand the various Life cycles models of software engineering.	**2**
CO2	Students will be able to perform the analysis of object models and dynamic models.	**3**
CO3	Students will be able to decompose the system and manage the system design.	**4**
CO4	Students will be able to understand the changes occurred during development stage and handle them.	**2**
CO5	Students will be able to learn SOP and AOP concepts.	**2**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd ed, Pearson Education, 2004.
2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
3. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.

REFERCENCES:

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.
2. AspectJ in Action, RamnivasLaddad, Manning Publications, 2003.
3. Aspect-Oriented Software Development, Robert E. Filman, TzillaElrad, Siobhan Clarke, and Mehmet Aksit, October 2006.
4. Mastering AspectJ: Aspect-Oriented Programming in Java, Joseph D. Gradecki and Nicholas Lesiecki, March 2003.

CP22105 FOUNDATIONS OF DATA SCIENCE

L	T	P	C
3	0	0	3

OBJECTIVES

The student should be made to:

- Understand the foundation for data science and application area related to it.
- Learn the Data science process.
- Apply appropriate Machine Learning algorithm in data science.
- Understand the concepts of data wrangling and data visualization.
- Understand the existence of data with its wilderness and make use of it.

UNIT I DATA SCIENCE FOR HANDLING BIG DATA 9

Introduction to data science - Benefits and uses of data science and big data - facets of data - Structured data - Unstructured data - Natural Language - Machine generated data, Audio, Image and video streaming data - The Big data Eco system- Distributed file system - Distributed Programming framework - Data Integration frame work - Machine learning Framework - NoSQL Databases - Scheduling tools - Benchmarking Tools - System Deployment - Service programming and Security.

UNIT II DATA SCIENCE PROCESS 9

Data Science Process - Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – Data Modeling - Model and variable selection - Model execution - Model diagnostic and model comparison - Presentation and automation - Presenting data - Automating data analysis.

UNIT III MACHINE LEARNING 9

Application for machine learning in data science- Tools used in machine learning- Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm - Supervised learning algorithms, Unsupervised learning algorithms.

UNIT IV PYTHON FOR DATA WRANGLING AND DATA VISUALIZATION 9

Basics of Numpy arrays –Aggregations –Computations on arrays –Comparisons, masks, boolean logic – Fancy indexing – Structured arrays – Data manipulation with Pandas – Data indexing and selection – Operating on data – Missing data – Hierarchical indexing – Combining datasets – Aggregation and grouping – Pivot tables- Importing Matplotlib – Line plots – Scatter plots – Visualizing errors – Density and contour plots – Histograms – Legends – Colors – Subplots – Text and annotation – Customization – Three dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.

UNIT V CASE STUDIES **9**

Distributing data storage and processing with frameworks - Case study: e.g, Assessing risk when lending money.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Importance of data science in handling big data.	**2**
CO2	Fundamental concepts of data science process.	**1**
CO3	Applications of machine learning in data science.	**3**
CO4	Implementation of Data wrangling and data visualization in Python.	**3**
CO5	Implementation of the aspects of Data Science through case studies.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

REFERCENCES:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2nd edition, 2019.
2. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press,2014.

CP22111 **ADVANCED DATASTRUCTURES AND ALGORITHMS LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES

- To acquire the knowledge of algorithms and applying to understand the advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graphs and its representation techniques.
- Perform the shortest minimum path calculation using graphs.

LIST OF EXPERIMENTS

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation
4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals (BFS and DFS)
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Prims Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

TOTAL : 60 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	To enable the students implement various data structures and algorithms for solving computational problems using the data structures construct.	**3**
CO2	To enable the students implement various Hierarchical Data Structures and develop the programs.	**3**
CO3	To enable the students implement Graph Data Structures for solving various problems like MST, Shortest path.	**3**
CO4	To enable the students apply various algorithmic design techniques for solving various problems	**3**
CO5	Solve various problems with minimal time complexity.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Server with C++ compiler supporting 30 terminals or more

CP22112 MACHINE LEARNINGLABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

The Student should be made to:

- Learn and understand the use of different python libraries.
- Understand the application of various data exploration and data visualization techniques.
- Implement supervised learning algorithms.
- Implement unsupervised learning algorithms.
- Learn to analyze the performance of different machine learning algorithms on various datasets.

LIST OF EXPERIMENTS

1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib, Scikit.
2. Perform Data Exploration and Preprocessing.
3. Implementation of Bayesian Linear Regression.
4. Implementation of Bayesian Logistic Regression.
5. Implementation of Naive Bayes' Classification.
6. Implementation of Decision trees.
7. Implementation of Support Vector Machine with different kernels.
8. Implementation of Back Propagation Neural Network.
9. Implementation of Multilayer Perceptron.
10. Implementation of Regression Tree.
11. Implementation of K-Nearest Neighbor Classification.
12. Implementation of K-mean Clustering.
13. Implementation of Gradient Boosting Ensemble Model.
14. Implementation of Principle Component Analysis for Feature Selection

TOTAL : 60 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to apply appropriate data preprocessing techniques.	**3**
CO2	Students will be able to develop and implement various machine learning algorithms.	**3**
CO3	Students will be able to apply python packages to implement machine learning algorithms.	**3**
CO4	Students will be able to identify the suitable machine learning algorithm for the given problem.	**3**
CO5	Students will be able to compare and analyze the performance of different algorithms.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

HARDWARE:

Standalone desktops – 30 Nos. (or) Server supporting 30 terminals or more

SOFTWARE:

Anaconda IDE in Ubuntu OS Server with C++ compiler supporting 30 terminals or more

CP22201 CLOUD SERVICES AND VIRTUALIZATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concepts of virtualization and virtual machines.
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing.
- To understand the various issues in cloud computing.
- To be able to set up a private cloud.
- To understand the security issues in the cloud environment.

UNIT I VIRTUALIZATION & VIRTUAL MACHINES 9

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Process Virtual Machines- Virtual machine Implementation – Memory architecture emulation – Instruction emulation – Exception Emulation – Operating System emulation.

UNIT II VIRTUALIZATION INFRASTRUCTURE 9

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – Virtualization Structures/Tools and Mechanisms - virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT III CLOUD PLATFORM ARCHITECTURE 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges - Public Cloud Platforms : GAE, AWS – Inter-cloud Resource Management – Extended cloud computing services-Resource provisioning and platform deployment – virtual machine creation and management –global exchange of cloud resources.

UNIT IV PROGRAMMING MODEL 9

Parallel and distributed Programming Paradigms – Parallel computing and programming paradigms – MapReduce, Twister and Iterative MapReduce- Hadoop Library from Apache – Dryad and DryadLINQ from Microsoft – Mapping applications to Parallel and Distributed Systems. Emerging cloud Software

Environments – Open source Eucalyptus and Nimbus, Open Nebula, Open Stack, Manjrasoft Aneka Cloud and Appliances.

UNIT V CLOUD SECURITY 9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management – Cloud security defense strategies – Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques – Reputation-Guided Protection of Data Centers.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Employ the concepts of storage virtualization, network virtualization and its management.	**3**
CO2	Apply the concept of virtualization in the cloud computing.	**3**
CO3	Identify the architecture, infrastructure and delivery models of cloud computing.	**1**
CO4	Develop services using Cloud computing.	**5**
CO5	Apply the security models in the cloud environment.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

REFERCENCES:

1. James E. Smith, Ravi Nair, " Virtual Machines", Denise E.M. Penrose Publisher, 2005.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O‘Reilly Media, Inc.,2009.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
4. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.
5. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

CP22202 **CYBER SECURITY TECHNIQUES**

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the concepts of cryptographic techniques.
- To familiarize various cybercrimes and cyber offenses.
- To learn and understand cyber threats, attacks and prevention.
- To learn about the basic concepts of Ethical hacking and Penetration Testing.
- To acquire knowledge on foot printing and different vulnerabilities in social networks.

UNIT I CRYPTOGRAPHIC TECHNIQUES 9

Symmetric key cryptographic techniques: Introduction to Stream cipher, Block cipher: DES, AES,IDEA Asymmetric key cryptographic techniques: principles, RSA, ElGamal, Elliptic Curve cryptography, Key distribution and Key exchange protocols.

UNIT II CYBERCRIMES AND CYBER OFFENSES 9

Classification of cybercrimes, planning of attacks, social engineering: Human based, Computer based: Cyberstalking, Cybercafe and Cybercrimes.

UNIT III CYBER THREATS, ATTACKS AND PREVENTION 9

Phishing, Password cracking, Keyloggers and Spywares, DoS and DDoS attacks, SQL Injection Identity Theft (ID) : Types of identity theft, Techniques of ID theft.

UNIT IV ETHICAL HACKING 9

Types of Data Stolen From the Organizations, Elements of Information Security, Authenticity and NonRepudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

UNIT V FOOT PRINTING AND SOCIAL ENGINEERING 9

Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to implement the cryptographic techniques to real time applications.	**3**
CO2	Students will be able to know fundamentals of cybercrimes and the cyber offenses.	**1**
CO3	Students will be able to realize the cyber threats, attacks, vulnerabilities and its defensive mechanism.	**2**
CO4	Students will be able to understand the basic concepts of Ethical hacking and Penetration Testing.	**2**
CO5	Students will be able to understand foot printing and different vulnerabilities in social networks.	**2**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Cyber Security, Understanding cyber crimes, computer forensics and legal perspectives, Nina Godbole,SunitBelapure, Wiley Publications, Reprint 2016.
2. Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning, 2010.

REFERCENCES:

1. Cryptography and Network security, William Stallings, Pearson Education, 7th Edition, 2016.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series – Elsevier, August 4, 2011.
3. Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning, 2009-11-01.

CP22203 **INTERNET OF THINGS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT connectivity and layers.
- To build a system using RaspberryPi and other IoT devices.
- To apply the concept of Internet of Things in the real-world scenario.

UNIT I ARCHITECTURES AND MODELS **9**

Introduction to IoT – IoT Architectures – Core IoT Functional Stack, Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer – IoT Data Management and Compute Stack, Fog Computing, Edge Computing, Cloud Computing – Sensors, Actuators, Smart Objects, Sensor networks.

UNIT II CONNECTIVITY **9**

Communications Criteria – Access Technologies – IP as IoT Network Layer – Business case – Optimization – Profiles and compliances – Application Protocols – Transport Layer – Application Transport Methods.

UNIT III SYSTEM DEVELOPMENT **9**

Design Methodology – Case study – Basic blocks of IoT device – Raspberry Pi – Board, Interfaces, Linux, Setting up, Programming – Arduino – Other IoT Devices.

UNIT IV DATA ANALYTICS AND IoT SECURITY **9**

Data Analytics for IoT – Big Data Analytics Tools and Technology – Edge Streaming Analytics – Network Analytics, Applications. Security history, challenges, variations – Risk Analysis Structures Application in Operational Environment.

UNIT V IOT IN INDUSTRY **9**

Manufacturing, Architecture, Protocols – Utilities, Grid Blocks - Smart Cities, Architecture, Use cases – Transportation, Architecture, Use cases.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Realize the Architecture and Components.	**3**
CO2	Frame connectivity to access/control IoT devices.	**3**
CO3	Construct a portable IoT using RaspberryPi.	**3**
CO4	Produce secured models of an IoT application.	**3**
CO5	Examine applications of IoT in real-time scenarios.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017
2. Olivier Hersent, David Boswarthick, Omar Elloum, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

REFERCENCES:

1. Michael Miller, "The Internet of Things", Pearson Education, 2015.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

CP22204 **BIG DATA ANALYTICS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the computational approaches to Modeling, Feature Extraction.
- To understand the need and application of Map Reduce.
- To understand the various search algorithms applicable to Big Data.
- To analyze and interpret streaming data.
- To learn how to handle large data sets in main memory and learn the various clustering techniques applicable to Big Data.

UNIT I DATA MINING AND LARGE SCALE FILES **9**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II SIMILAR ITEMS **9**

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions –LSH Families – Methods for High Degree of Similarities**.**

UNIT III MINING DATA STREAMS **9**

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS **9**

Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

UNIT V CLUSTERING **9**

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non- Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems**.**

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Design algorithms by employing Map Reduce technique for solving Big Data problems.	**3**
CO2	Design algorithms for Big Data by deciding on the apt Features set.	**3**
CO3	Design algorithms for handling petabytes of datasets.	**3**
CO4	Design algorithms and propose solutions for Big Data by optimizing main memory consumption.	**3**
CO5	Design solutions for problems in Big Data by suggesting appropriate clustering techniques.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, "Mining of Massive Datasets",Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, MichelineKamber, Jian Pei, "Data Mining Concepts and Techniques", MorganKaufman Publications, Third Edition, 2012.
3. Ian H.Witten, Eibe Frank "Data Mining – Practical Machine Learning Tools andTechniques", Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, "Principles of Data Mining", MIT PRESS,2001.

GR22251

INTRODUCTION TO RESEARCH METHODOLOGY AND IPR

(COMMON TO ALL BRANCHES)

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection**.**

UNIT I RESEARCH METHODOLOGY 9

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT II RESULTS AND ANALYSIS 9

Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective) and cross verification, correlation with published results, discussion, outcome as new idea, hypothesis, concept, theory, model etc.

UNIT III TECHNICAL WRITING 9

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

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

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

UNIT V PATENT RIGTS AND NEW DEVELOPMENTS IN IPR 9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs**.**

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Critically evaluate any research article based upon research methodology.	**4**
CO2	Correlate the results of any research and develop hypothesis, concept, theory and model.	**2**
CO3	Developing a research proposal, research presentation and review article in the field of engineering.	**5**
CO4	Enumerate the importance of intellectual property right in research.	**4**
CO5	Develop proposal for patent rights and identify the new developments in IPR.	**5**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, fourth edition, 2019..
2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students', Juta& Company, 1996.
3. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.

CP22211 **DATA ANALYTICS LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES

- To implement MapReduce for real-time big data applications.
- To identify similarity measures in documents.
- To implement various algorithms for mining data streams.
- To implement algorithms for link analysis and frequent item sets.
- To implement various Machine learning clustering algorithms to process Big Data.

LIST OF EXPERIMENTS

1. Implement word count program using MapReduce
2. Implement MapReduce to processes weather dataset
3. Implement Nearest Neighbor Search
4. Text Similarity using K-Shingling, Minhashing, and Locality Sensitive Hashing
5. Implement Bloom Filter for Mining Data Stream
6. Implement DGIM algorithm
7. Apriori Algorithm in Python- Market Basket Analysis
8. Implement SON algorithm
9. Implement K-Means clustering algorithm
10. Implement CURE clustering algorithm

TOTAL : 30 PERIODS

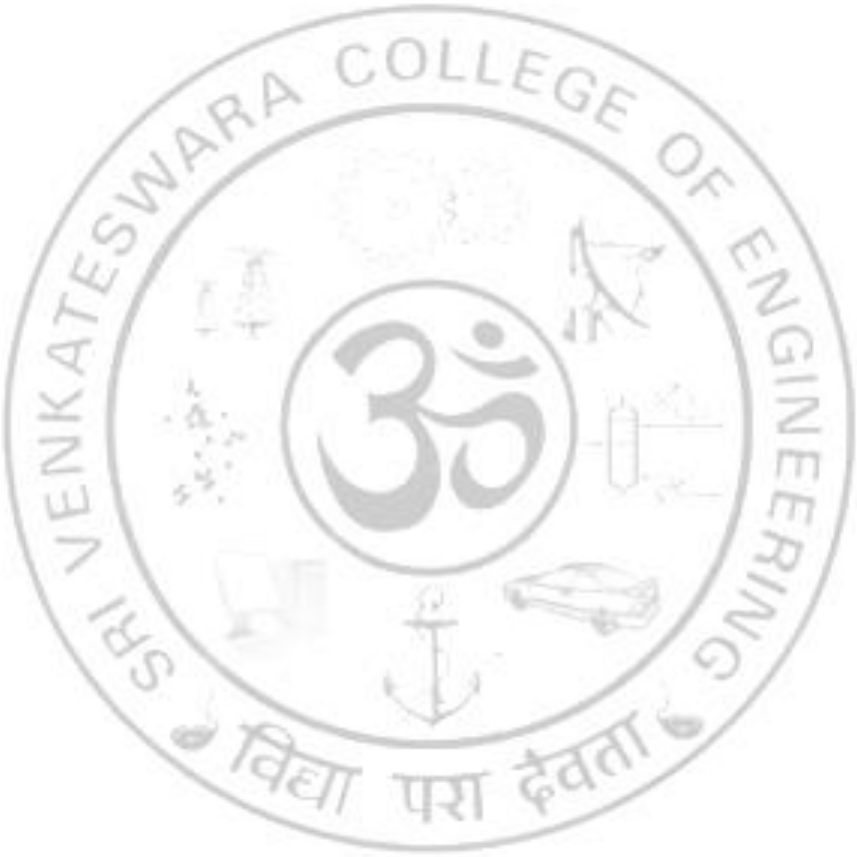
OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Design algorithms by applying MapReduce for solving big data problems.	**3**
CO2	Design algorithms for Big Data by deciding on the apt Features set.	**3**
CO3	Design algorithms for mining data streams.	**3**
CO4	Propose solutions for Big Data by optimizing main memory consumption.	**4**
CO5	Identify the suitable Machine Learning algorithms for suggesting appropriate clustering techniques.	**1**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Server with C++ compiler supporting 30 terminals or more



CP22212 **INDUSTRIAL VISIT AND TECHNICAL SEMINAR**

L	T	P	C
0	0	2	1

OBJECTIVES

- Students will develop their scientific and technical reading and writing skills
- Students will able to understand and construct research articles.
- A term paper requires a student to obtain information from a variety of sources (i.e., Jour dictionaries, reference books) and then place it in logically developed ideas.

LIST OF EXPERIMENTS

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective of the proposed work.
3. Collecting the relevant technical papers (at least 15 journal papers)
4. Preparing a working outline with suitable architecture.
5. Studying the papers and understanding the authors contributions and critically analyzing each paper.
6. Preparing a working outline with suitable solution
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation
10. Final Report Submission

TOTAL : 30 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Identify the research domain and the research work	**3**
CO2	Review the literature and analyze the developments in the domain	**3**
CO3	Develop a test bed and research methodology	**4**
CO4	Analyze the test results and provide justification	**3**
CO5	Prepare the research report	**4**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

CP22002 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basic concepts of product design and development.
- To know the implications in product architecture and the importance of industrial design.
- To understand prototyping basics and influence of diverse factors on project success

UNIT I INTRODUCTION - DEVELOPMENT PROCESSES AND ORGANIZATIONS PRODUCT PLANNING **9**

Characteristics of successful product development to Design and develop products, duration and cost of product development, the challenges of product development. A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization. The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

UNIT II IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS **9**

Gathering raw data from customers, interpreting raw data in terms of customer needs, organizing the needs into a hierarchy, establishing the relative importance of the needs and reflecting on the results and the process. Specifications, establish specifications, establishing target specifications setting the final specifications.

UNIT III CONCEPT GENERATION - CONCEPT SELECTION - CONCEPT TESTING **9**

The activity of concept generation clarify the problem search externally, search internally, explore systematically, reflect on the results and the process, Overview of methodology, concept screening, concept scoring, caveats. Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

UNIT IV PRODUCT ARCHITECTURE - INDUSTRIAL DESIGN - DESIGN FOR MANUFACTURING **9**

Meaning of product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, is assessing the quality of industrial design. Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

UNIT V **PROTOTYPING - PRODUCT DEVELOPMENT ECONOMICS - MANAGING PROJECTS** **9**

Prototyping basics, principles of prototyping, technologies, planning for prototypes, Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis. Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Design algorithms by employing Map Reduce technique for solving Big Data problems.	**4**
CO2	Design algorithms for Big Data by deciding on the apt Features set.	**2**
CO3	Design algorithms for handling petabytes of datasets.	**5**
CO4	Design algorithms and propose solutions for Big Data by optimizing main memory consumption.	**4**
CO5	Design solutions for problems in Big Data by suggesting appropriate clustering techniques.	**5**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Karl Ulrich,T, Steven Eppinger, D, “Product Design and Development”, McGrawHill, 2015.
2. Chitale, AK, Gupta, RC, “Product Design and Manufacturing” PHI, 2013.
3. Timjones, “New Product Development:An Introduction to a multifunctional process”, Butterworth-Heinemann, 1997.
4. GeofferyBoothroyd, Peter Dewhurst and Winston Knight,A, “Product Design for Manufacture and Assembly”, CRC Press, 2011.

CP22204 **AGILE METHODOLOGIES**

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the fundamental principles and practices associated with each of the agile development methods.
- To apply the principles and practices of agile software development on a project of interest and relevance to the student.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand agile development and testing.

UNIT I AGILE SOFTWARE DEVELOPMENT **9**

Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, Stakeholders, Challenges. Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality. Data About Agile Software Development and its Learning Environments, Application of Agile Software Development.

UNIT II AGILE AND SCRUM PRINCIPLES **9**

Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, Working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values, Adapting to Scrum, Patterns for Adopting Scrum, Iterating toward agility.

UNIT III AGILE PRODUCT AND PROJECT MANAGEMENT **9**

Communication, Planning, Estimation Managing the Agile Approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile Approach Monitoring progress, Targeting and motivating the team, managing business involvement and Escalating issue. Agile Project Management Roles, Approach and Practices.

UNIT IV AGILE REQUIREMENTS AND AGILE TESTING **9**

User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development, User Acceptance Test, Case Study: Payroll.

UNIT V AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS 9

Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, the rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools. Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Analyze existing problems with the team, development process and wider organization.	**2**
CO2	Apply a thorough understanding of Agile principles and specific practices.	**3**
CO3	Select the most appropriate way to improve results for a specific circumstance or need.	**3**
CO4	Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems.	**4**
CO5	Evaluate likely successes and formulate plans to manage likely risks or problems.	**5**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Robert C. Martin, "Agile Software Development, Principles, Patterns, and Practices Alan Apt Series, 2011.
2. Charles G. Cobb, PMP, "Making sense of Agile Project Management- Balancing Control and Agility", Wiley Publications, 2011.

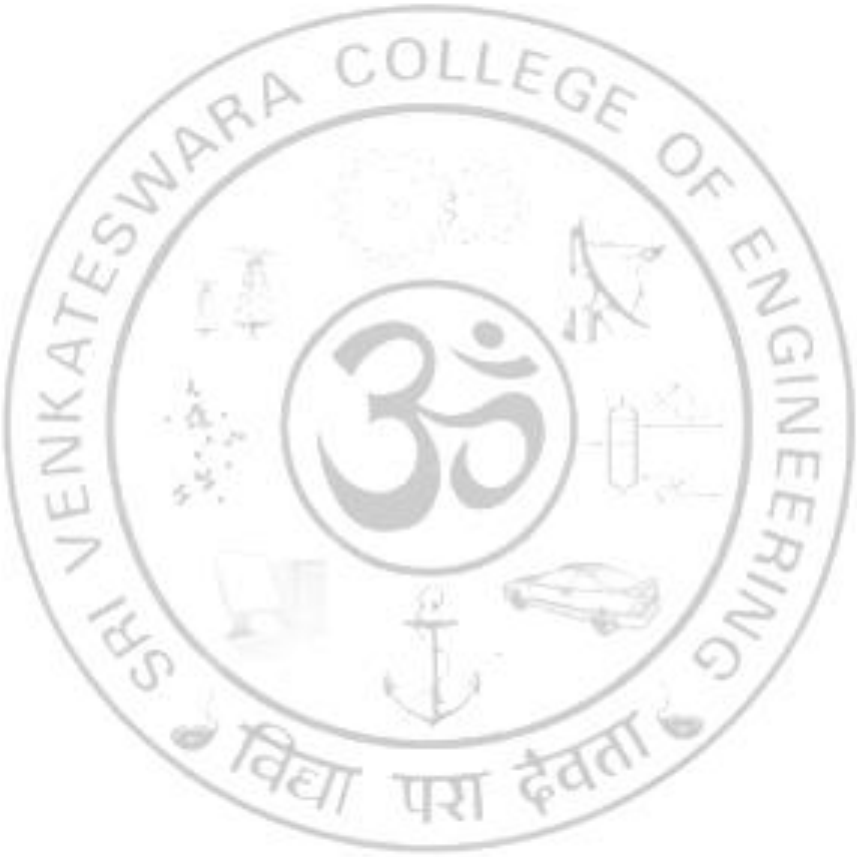
REFERCENCES:

1. Succeeding with Agile: Software Development Using Scrum, Pearson, 2010.
2. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.
3. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer

Science", Springer, 2009.

4. Craig Larman, "Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004.

5. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.



CP22006 **QUANTUM COMPUTING**

L	T	P	C
3	0	0	3

OBJECTIVES

The student should be made to:

- Understand the basics of Quantum Computing and the paradigm.
- Learn how the Quantum Computing will differ from Conventional Computing.
- Understand the concepts of Qubits and various Quantum Computation algorithms.
- Be aware of Quantum Computing on various fields such as Computer Security and Machine learning.

UNIT I FOUNDATION **9**

Overview of traditional computing – Church-Turing thesis – circuit model of computation– reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem –functions of operators – tensor products – Schmidt decomposition theorem.

UNIT II QUBITS AND QUANTUM MODEL OF COMPUTATION **9**

State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits.

UNIT III QUANTUM ALGORITHMS - I **9**

Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch- Jozsa algorithm – Simon's algorithm – Quantum phase estimation and quantum Fourier Transform – eigenvalue estimation.

UNIT IV QUANTUM ALGORITHMS – II **9**

Order-finding problem – eigenvalue estimation approach to order finding – Shor's algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover's quantum search algorithm – amplitude amplification – quantum amplitude estimation – quantum counting – searching without knowing the success probability.

UNIT V QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION **9**

Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction –

classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant quantum computation.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	The basic principles of quantum computing.	**1**
CO2	The fundamental differences between conventional computing and quantum computing.	**2**
CO3	Several basic quantum computing algorithms.	**2**
CO4	Concept of Qubits and various computing models.	**1**
CO5	The classes of problems that can be expected to be solved well by quantum computers.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. P. Kaye, R. Laflamme, and M. Mosca, "An introduction to Quantum Computing", Oxford University Press, 1999.

REFERCENCES:

1. V. Sahni, "Quantum Computing", Tata McGraw-Hill Publishing Company, 2007.
2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.

CP22008 **SOCIAL NETWORK ANALYSIS**

L	T	P	C
3	0	0	3

OBJECTIVES

The student should be made to:

- To make sense of the social and information networks that have been fuelled and rendered accessible by the internet.
- To Analyse social networks by finding communities, identifying important nodes and influence propagation.

UNIT I INTRODUCTION **9**

Overview: Social network data-Formal methods- Paths and Connectivity-Graphs to represent social relations-Working with network data- Network Datasets-Strong and weak ties - Closure, Structural Holes, and Social Capital.

UNIT II SOCIAL INFLUENCE **9**

Homophily: Mechanisms Underlying Homophily, Selection and Social Influence, Affiliation, Tracking Link Formation in OnLine Data, Spatial Model of Segregation - Positive and Negative Relationships - Structural Balance - Applications of Structural Balance, Weaker Form of Structural Balance.

UNIT III INFORMATION NETWORKS AND THE WORLD WIDE WEB **9**

The Structure of the Web- World Wide Web- Information Networks, Hypertext, and Associative Memory- Web as a Directed Graph, Bow-Tie Structure of the Web- Link Analysis and Web Search-Searching the Web: Ranking, Link Analysis using Hubs and Authorities- Page Rank- Link Analysis in Modern Web Search, Applications, Spectral Analysis, Random Walks, and Web Search.

UNIT IV SOCIAL NETWORK MINING **9**

Clustering of Social Network graphs: Betweenness, Girvan newman algorithm-Discovery of communities- Cliques and Bipartite graphs-Graph partitioning methods-Matrices-Eigen values Simrank.

UNIT V NETWORK DYNAMICS **9**

Cascading Behavior in Networks: Diffusion in Networks, Modeling Diffusion - Cascades and Cluster, Thresholds, Extensions of the Basic Cascade Model- Six Degrees of Separation-Structure and Randomness, Decentralized Search- Empirical Analysis and Generalized Models- Analysis of Decentralized Search.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Understand the Evolution of Social Networks	**1**
CO2	Analyze the structure of Social Networks	**4**
CO3	Explore the knowledge from disciplines as diverse as sociology, mathematics, computer science	**3**
CO4	Discuss the Online interactive demonstrations and hands-on analysis of real-world data sets.	**1**
CO5	Understand the Cascading Behavior in Social Networks.	**1**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Easley and Kleinberg, "Networks, Crowds, and Markets: Reasoning about a highly connected world", Cambridge Univ. Press, 2010.
2. Robert A. Hanneman and Mark Riddle, "Introduction to social network methods", University of California, 2005.
3. Jure Leskovec,StanfordUniv.AnandRajaraman, Milliway Labs, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2 edition, 2014.
4. Wasserman, S.,& Faust, K, "Social Network Analysis: Methods and Applications", Cambridge University Press; 1 edition, 1994.
5. Borgatti, S. P., Evercloudett, M. G., & Johnson, J. C., "Analyzing social networks", SAGE Publications Ltd; 1 edition, 2013.
6. John Scott , "Social Network Analysis: A Handbook" , SAGE Publications Ltd; 2nd edition, 2000.

CP22010 **ADVANCED ALGORITHMS**

L	T	P	C
3	0	0	3

OBJECTIVES

The student should be made to:

- To analyse the asymptotic performance of algorithms.
- To synthesize efficient algorithms in common engineering design situations.
- To apply important algorithmic design paradigms and methods of analysis.

UNIT I BASICS OF ALGORITHM ANALYSIS **9**

Representative Problems – Computational Tractability – Asymptotic Order of Growth – Implementing the Stable Matching Algorithm Using Lists and Arrays – A survey of common running times – A more Complex Data Structure: Priority Queues.

UNIT II GRAPHS ALGORITHMS **9**

Graphs: Basic Definitions and Applications – Graph connectivity and Graph traversal – Implementing Graph Traversal using Queues and Stacks – Testing Bipartiteness: An application of Breadth First search. **Greedy Algorithms:** Interval Scheduling: The Greedy Algorithm Stays Ahead – Optimal Caching: A More Complex Exchange Argument – The Minimum Spanning Tree Problem – Implementing Kruskal's Algorithm: The Union-Find Data Structure – Clustering – Huffman Codes and Data Compression.

UNIT III DIVIDE AND CONQUER **9**

A First Recurrence: The Mergesort Algorithm – Further Recurrence Relations – Counting Inversions – Finding the Closest Pair of Points – Integer Multiplication.

Dynamic Programming: Weighted Interval Scheduling: A Recursive Procedure – Principles of Dynamic Programming: Memoization or Iteration over Subproblems - Multi-way Choices – Subset Sums and Knapsacks.

UNIT IV NETWORK FLOW **9**

The Maximum-Flow Problem and the Ford-Fulkerson Algorithm – Maximum Flows and Minimum Cuts in a Network – Choosing Good Augmenting Paths – A First Application: The Bipartite Matching Problem – Disjoint Paths in Directed and Undirected Graphs.

UNIT V RANDOMIZED ALGORITHMS **9**

Contention Resolution - Finding the Global Minimum Cut - Random Variables and Their Expectations - A Randomized Approximation Algorithm - Randomized Divide and Conquer - Hashing - Finding the

Closest Pair of Points

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Analyze algorithms to determine algorithm correctness and time efficiency.	**3**
CO2	Master a variety of advanced data structures and their implementations.	**2**
CO3	Master a variety of different algorithm design techniques.	**2**
CO4	Apply and implement the learnt algorithm design techniques to solve problems.	**4**
CO5	Understand the NP completeness problems	**1**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Jon Kleinberg, ÉvaTardos, "Algorithm Design",Pearson Education Limited 2014.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 2009.
3. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, Hyderabad, 2008.
4. AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2008.

CP22012 **RECOMMENDER SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES

The student should be made to:

- To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering.
- To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations.

UNIT I INTRODUCTION **9**

Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT II CONTENT-BASED FILTERING **9**

User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

UNIT III COLLABORATIVE FILTERING **9**

User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

UNIT IV HYBRID APPROACHES **9**

Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies

UNIT V EVALUATING RECOMMENDER SYSTEM **9**

Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Understand the filtering techniques and issues in the recommender system.	**3**
CO2	Master the content –based filtering and collaborative filtering techniques.	**2**
CO3	Master the hybrid approaches in the Recommender system.	**2**
CO4	Design recommendation system for a particular application domain.	**4**
CO5	Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity.	**5**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st edition
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st edition.
3. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st edition.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st edition.

CP22014 INFORMATION RETRIEVAL TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search.
- To learn measuring effectiveness and efficiency of information retrieval techniques.
- To get used to performing Parallel Information Retrieval.
- To understand the concepts of digital libraries.

UNIT I INTRODUCTION **9**

Introduction - Information Retrieval - The IR problem - The IR System- The Web- User Interface for Search - Search Interface Today - Visualization in Search Interface- Design and Evaluation of Search Interface.

UNIT II RETRIEVAL MODELING **9**

Taxonomy and Characterization of IR Models – Classic Information Models- Boolean Model – Term Weighting- TF-IDF Weights - Document Length Normalization - Vector Model – Probabilistic Models - Comparison of Classic Information Models - Set Theoretic Models - Set- Based Models - Extended Boolean Model - Fuzzy Set Model - Algebraic Models - Generalized Vector Space Model - Latent Semantic Indexing Model - Neural Network Model - Probabilistic Model - Bayesian Network Model.

UNIT III RETRIEVAL EVALUATION , RELEVANCE FEEDBACK AND QUERY EXPANSION **9**

Introduction - The Cranfield Paradigm - Retrieval Metrics- Reference Collections- User based Evaluation - Framework for Feedback - Explicit Relevance Feedback- Feedback through Clicks- Feedback through Global and Local Analysis.

UNIT IV INDEXING AND SEARCHING **9**

Static and Dynamic Inverted Indices – Index Construction and Index Compression - Signature Files- Suffix Tree and Suffix Array - Sequential Searching - Multidimensional Indexing.

UNIT V WEB RETRIEVAL **9**

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web

Crawling and Indexing – Link Analysis – XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Build an Information Retrieval system using the available tools.	**5**
CO2	Identify and design the various components of an Information Retrieval system.	**1**
CO3	Measure effectiveness and efficiency of information retrieval techniques.	**5**
CO4	Use parallel Information Retrieval approaches in real world problems.	**3**
CO5	Design an efficient search engine and analyze the Web content structure.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", (ACM Press Books), Second Edition, 2011.
2. Chrstopher D. Manning, PrabhakarRaghavan, HinrichSchutze, "Introduction to Information Retrieval", Cambridge University Press, First South Asian Edition, 2008.
3. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval Implementing and Evaluating Search Engines", The MIT Press, Cambridge, Massachusetts London, England, 2010.

CP22016 NATURAL LANGUAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand basics of linguistics, probability and statistics.
- To study statistical approaches to NLP and understand sequence labeling.
- To outline different parsing techniques associated with NLP.
- To explore semantics of words and semantic role labeling of sentences.
- To understand discourse analysis, question answering and chatbots.

UNIT I INTRODUCTION 9

Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology-Finite State Automata.

UNIT II STATISTICAL NLP AND SEQUENCE LABELING 9

N-grams and Language models –Smoothing -Text classification- Naïve Bayes classifier – Evaluation - Vector Semantics – TF-IDF - Word2Vec- Evaluating Vector Models -Sequence Labeling – Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging.

UNIT III CONTEXTUAL EMBEDDING 9

Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm- Evaluating Parsers -Partial Parsing – Dependency Relations- Dependency Parsing - Transition Based - Graph Based.

UNIT IV COMPUTATIONAL SEMANTICS 9

Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling – Proposition Bank- FrameNet- Selectional Restrictions - Information Extraction - Template Filling.

UNIT V DISCOURSE ANALYSIS AND SPEECH PROCESSING 9

Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Understand basics of linguistics, probability and statistics associated with NLP.	**5**
CO2	Implement a Part-of-Speech Tagger.	**1**
CO3	Design and implement a sequence labeling problem for a given domain.	**5**
CO4	Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP.	**3**
CO5	Implement a simple chatbot using dialogue system concepts.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" (Prentice Hall Series in Artificial Intelligence), 2020.
2. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019.
3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019.
4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009.
5. Nitin Indurkhya,Fred J. Damerau, "Handbook of Natural Language Processing", Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010.
6. Deepti Chopra, Nisheeth Joshi, "Mastering Natural Language Processing with Python", Packt Publishing Limited, 2016.
7. Mohamed ZakariaKurdi "Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax (Cognitive Science)", ISTE Ltd., 2016.
8. AtefehFarzindar,DianaInkpen, "Natural Language Processing for Social Media (Synthesis Lectures on Human Language Technologies)", Morgan and Claypool Life Sciences, 2015.

CP22018 **VISUALIZATION TECHNIQUES**

L	T	P	C
3	0	0	3

OBJECTIVES

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand technological advancements of data visualization.
- To understand various data visualization techniques.
- To understand the methodologies used to visualize large data sets.

UNIT I INTRODUCTION AND DATA FOUNDATION **9**

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets

UNIT II FOUNDATIONS FOR VISUALIZATION **9**

Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.

UNIT III VISUALIZATION TECHNIQUES **9**

Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.

UNIT IV INTERACTION CONCEPTS AND TECHNIQUES **9**

Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.

UNIT V RESEARCH DIRECTIONS IN VISUALIZATIONS 9

Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation , Hardware and Applications.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	To visualize the objects in different dimensions	**4**
CO2	To design and process the data for Visualization.	**4**
CO3	To apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences	**3**
CO4	To apply the virtualization techniques for research projects	**3**
CO5	To identify appropriate data visualization techniques given particular requirements imposed by the data.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010.
2. Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan Kaufmann Publishers, 2021.
3. Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007
4. Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008

CP22020 **DEEP LEARNING**

L	T	P	C
3	0	0	3

OBJECTIVES

- To develop and Train Deep Neural Networks..
- To develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition.
- To build and train RNNs, work with NLP and Word Embeddings.
- To understand the internal structure of LSTM and GRU and the differences between them
- To understand the the Auto Encoders for Image Processing.

UNIT I DEEP LEARNING CONCEPTS **9**

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS **9**

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters

UNIT III CONVOLUTIONAL NEURAL NETWORK **9**

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. RCNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO.

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN **9**

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Cooccurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 9

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	To implement feature Extraction from Image and Video Data	**3**
CO2	To implement Image Segmentation and Instance Segmentation in Images.	**3**
CO3	To implement image recognition and image classification using a pretrained network (Transfer Learning).	**3**
CO4	To implement traffic information analysis using Twitter Data.	**3**
CO5	To implement Autoencoder for Classification & Feature Extraction.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, JojoMoolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, SantanuPattanayak, Apress,2017.

CP22309 **ADVANCED NEURAL NETWORKS**

L	T	P	C
3	0	2	4

OBJECTIVES

- To understand the theoretical foundations, algorithms and methodologies of Neural Network
- To design and develop an application using specific deep learning models

UNIT I NEURAL NETWORKS BASICS **9 + 6**

What is a Neural Network? The Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Feedback, Networks Architectures, Knowledge Representation, Learning Processes, Learning Tasks. Linear Regression Model. The Perceptron Convergence Theorem.

Exp 1: Basic Exercises in Python
Exp 2: Linear Regression - Generating the Dataset, Reading the Dataset, Initializing Model Parameters, Defining the Model, Defining the Loss Function, Defining the Optimization Algorithm, Training and Testing.
Exp 3: Study of TensorFlow Keras models in python

UNIT II LMS ALGORITHM, MULTILAYER PERCEPTRONS **9 + 6**

Filtering Structure, The Wiener Filter, Least-Mean-Square Algorithm. Multilayer Perceptron's - Batch learning and On-Line Learning, The Back-Propagation Algorithm – XOR Problem. Radial-Basis-Function Networks, K-Means Clustering. Support Vector Machines - Optimal Hyperplane for Linearly Separable and Non separable Patterns, The Support Vector Machine Viewed as a Kernel Machine, Design of Support Vector Machines, XOR Problem. Regularization Networks.

Exp 1: Support Vector Classification – Import the libraries, Load the dataset, Split the dataset into X and Y, Split the X and Y dataset into the training set and test set, Perform feature scaling, Fit SVM to the training set, Predict the Test set results, Make the confusion Matrix, Visualize the test set results.

UNIT III DEEP LEARNING ARCHITECTURES **9 + 6**

Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions - RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders.

Exp 1: Implementation of different activation functions.

UNIT IV CONVOLUTIONAL NEURAL NETWORKS & RECURRENT NETWORKS **9 + 6**

Convolutional Neural Networks (CNN)- Biological inspiration – Intuition – CNN overview- Convolution Layers – Pooling Layers – Fully connected Layers. Recurrent Neural Networks - Modeling

the Time Dimension – 3D volumetric Input - General Recurrent Neural Network Architecture - LSTM networks – Domain Specific Applications and Blended Networks – Recursive Neural Networks.

Exp 1: Implementation of feature extraction in CNN

UNIT V RECENT TRENDS & APPLICATIONS 9 + 6

Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning. Vision, NLP, Speech.

Exp 1: Implementation of variational autoencoders.

TOTAL (L:45 P:30): 75 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Recognize the characteristics of deep learning models that are useful to solve real-world problems.	**2**
CO2	Be able to design, train, deploy neural networks for solving different practical/engineering problems and analyze and report its efficacy	**3**
CO3	Apply different architectures of deep convolution neural networks for image classification.	**3**
CO4	Explain recurrent neural networks for modelling sequential data.	**4**
CO5	Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. "Neural networks and learning machines", by Simon Haykin. Pearson, 2009
2. “Deep Learning”, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2017.

REFERCENCES:

1. Nikhil Buduma, Nicholas Locascio : Fundamentals of Deep Learning: Designing NextGenerationMachine.
2. Adam Gibson and Josh Patterson,” Deep Learning, A practitioner’s approach”, O’Reilly, First Edition, 2017.
3. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
4. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.
5. Pattern Recognition and Machine Learning, Christopher Bishop, 2007

CP22001 **WEB ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES

- To Understand the characteristics of web applications
- To learn to Model web applications
- Be aware of Systematic methods
- To familiarize with the testing techniques for web applications

UNIT I **INTRODUCTION TO WEB ENGINEERING AND REQUIREMENTS ENGINEERING** **9**

Motivation, Categories of Web Applications, Characteristics of Web Applications, Product-related Characteristics, Usage related Characteristics, Development-related Characteristic, Evolution of web engineering – Requirements Engineering Activities RE Specifics in Web Engineering, Principles for RE of Web Applications, Adapting RE Methods to Web Application Development, Requirement Types, Notations, Tools.

UNIT II **WEB APPLICATION ARCHITECTURES & MODELLING WEBAPPLICATIONS** **10**

Introduction- Categorizing Architectures, Specifics of Web Application Architectures, Components of a Generic Web Application Architecture, Layered Architectures, 2-Layer Architectures, N-Layer Architectures Data-aspect Architectures, Database-centric Architectures, Architectures for Web Document Management, Architectures for Multimedia Data Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Relation to Content, Hypertext, and Presentation Modeling

UNIT III **WEB APPLICATION DESIGN** **10**

Introduction, Web Design from an Evolutionary Perspective, Information Design, Software Design: A Programming Activity, Merging Information Design and Software Design, Problems and Restrictions in Integrated Web Design, A Proposed Structural Approach, Presentation Design, Presentation of Nodes and Meshes, Device-independent Development, Approaches, Inter action Design, User Interaction User Interface Organization, Navigation Design, Designing a Link Representation, Designing Link Internals, Navigation and Orientation, Structured Dialog for Complex Activities, Interplay with Technology and Architecture, Functional Design.

UNIT IV TESTING WEB APPLICATIONS **8**

Introduction, Fundamentals, Terminology, Quality Characteristics, Test Objectives, Test Levels, Role of the Tester, Test Specifics in Web Engineering, Test Approaches, Conventional Approaches, Agile Approaches, Test Scheme, Three Test Dimensions, Applying the Scheme to Web Applications, Test Methods and Techniques, Link Testing, Browser Testing, Usability Testing, Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, Test Automation, Benefits and Drawbacks of Automated Test, Test Tools.

UNIT V WEB PROJECT MANAGEMENT **8**

Understanding Scope, Refining Framework Activities, Building a Web Team, Managing Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS – web sockets

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students acquire knowledge on the characteristics of web applications and requirements engineering	
CO2	Students get familiar with web application architecture and model web applications.	
CO3	Students gain knowledge on design web applications from evolutionary perspective	
CO4	Students can apply the testing schemes to web applications	
CO5	Students get familiar with the activities involved in the web project management	

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Gerti Kappel, Birgit Proll, "Web Engineering", John Wiley and Sons Ltd, 2006.
2. Roger S. Pressman, David Lowe, "Web Engineering", Tata McGraw Hill Publication, 2007.
3. Guy W. Lecky-Thompson, "Web Programming", Cengage Learning, 2008.

REFERCENCES:

1. Chris Bates, "Web Programming: Building Internet Applications", Third Edition, Wiley India Edition, 2007
2. John Paul Mueller, "Web Development with Microsoft Visual Studio 2005", Wiley Dream tech, 2006.

CP22003 **FULL STACK WEB APPLICATION DEVELOPMENT**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concepts of web design and practice Markup language.
- To learn client side programming – JavaScript.
- To implement NoSQL MongoDB Database.
- To introduce e Server-side JS Framework.
- To explore on Front-end application development and the React library.

UNIT I INTRODUCTION TO WEB DESIGN **9**

Basic Internet protocols – WWW – Web Browsers - HTTP - Web 2.0 – Rich Internet Applications - HTML5: Elements – Attributes – Formatting – Colors - Media tags (audio and video tags) - Cascading Style Sheets.

UNIT II CLIENT SIDE PROGRAMMING: THE JAVASCRIPT LANGUAGE **9**

Introduction - Core features - Data types and Variables - Operators, Expressions and Statements - Functions & Scope - Objects - Array, Date and Math related Objects - Document Object Model – Event Handling - Browser Object Model - Windows and Documents - Form handling and validations. Object-Oriented Techniques in JavaScript - Classes – Constructors and Prototyping (Sub classes and Super classes) – JSON

UNIT III INTRODUCTION TO NOSQL DATABASE - MONGODB **9**

What is NoSQL Database –Features of MongoDB - Difference between MongoDB& RDBMS - Download & Installation – Basics of MongoDB– Implementation of Basic CRUD Operations using MongoDB

UNIT IV INTRODUCTION TO SERVER-SIDE JS FRAMEWORK – NODE.JS **9**

Introduction - What is Node JS – Architecture – Feature of Node JS - Installation and setup – Node.JS modules – Node.JS Package Management System – HTTP Servers and Clients – Event Handling – File System - Connect to NoSQL Database using Node JS – Implementation of CRUD operations.

UNIT V INTRODUCTION TO REACT AND ITS ROUTER **9**

Introduction to React: Platforms and Frameworks tools – Hybrid frameworks versus Native – React Environment Setup – React internals – React JSX – React Components and its styling– React Router: Parameters – Designing single page applications using React Router.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	The students will be able to apply HTML and CSS to develop interactive websites.	**3**
CO2	The students will be able to implement client-side scripting using JavaScript to design dynamic websites.	**4**
CO3	The students will be able to design web application with NoSQL Database connectivity.	**3**
CO4	The students will be to interpret Server-side JS frameworks.	**2**
CO5	The students will be able to accomplish the functional front-end web application using React.	**2**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 2020 6th edition, Pearson Education.
2. Vasan Subramanian, Pro MERN Stack - Full stack web app development, 2nd Edition, 2019

REFERCENCES:

1. Web Technologies-A Computer Science Perspective-Jeffrey C. Jackson, 4th Edition, 2007
2. David Herron, Node.JS Web Development, 5th Edition, Packt Publishing, 2020
3. Kirupa Chinnathambi, "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux", Second Edition, Pearson Education, 2018.

CP22005 BITCOIN AND BLOCKCHAIN TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basics, types and its application of Blockchain
- To learn about cryptographic basic and its security.
- To acquire knowledge about its architecture and consensus algorithm
- To understand the knowledge about Bitcoin Blockchain
- To understand the Knowledge about Ethereum Blockchain

UNIT I INTRODUCTION TO BLOCKCHAIN TECHNOLOGY 9

Distributed DBMS – Limitations of Distributed DBMS – Introduction to Blockchain – History-Definitions – Distributed Ledger –Blockchain Catagories –Public, Private, Consortium, Blockchain Networks and Nodes, Peer-Peer Networks, Mining Machanisms, Features of Blockchain.

UNIT II CRYPTOGRAPHIC BASICS IN BLOCKCHAIN 9

Cryptographic basics – Hashing – Signature Schemes – Encryption Schemes and Elliptic Curve Cryptography

UNIT III ARCHITECTURE 9

Blockchain Architecture – Blocks – Hash –Distributed Peer-Peer, Structure of Blockchain –Consensus Mechanisms- Proof of work (PoW) –Proof of Stake (PoS) –Byzantine Fault Tolerance (BFT) – Proof of Authority (PoA) – Proof of Elapsed Time (PoET).

UNIT IV BITCOIN 9

Introduction- Wallet – Blocks –Merkley Tree – Hardness of Mining – Transaction Verifiability – Anonymity – Forks – Double Spending – Mathematical Analysis of Properties of Bitcoin.

UNIT V ETHEREUM 9

Ethereum – Ethereum Virtual Machines – Wallets for Ethereum – Solidity – Smart Contracts – Some attacks on Smart Contracts.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	To gain knowledge about the basics, types and its application of Blockchain	**2**
CO2	To acquire knowledge about cryptographic and its basics.	**2**
CO3	Gain familiarity about is design and consensus algorithm	**3**
CO4	To gain knowledge about Bitcoin technology	**2**
CO5	To gain knowledge about Ethereum.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Arvind Narayanan, Joseph Bonneau, Edward Feltan, Andrew Miller and Steven Goldfeder. Bitcoin and CrypotoCurrency Technologies: a comprehensive introduction. Princeton University Press, 2016
2. A Garay et. Al, the bitcoin backbone protocol – Analysis and its applications EUROCRYPT 2015 LNCS VOL 9057 – Vol II, pp 281-310.

REFERCENCES:

1. William Stalling, "Cryptography and Network Security Principles and practices", Pearson edition 2017
2. R Pass et.al, Fruitchain, a fair blockchain, PODC 2017 (eprint.iacr.org/2016/916)

CP22007 SOFTWARE ARCHITECTURES AND DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the design principles and to apply for large scale systems
- To design architectures for distributed heterogeneous systems, environment through brokerage interaction
- To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

UNIT I **9**

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II **9**

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC).

UNIT III **9**

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM,CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture-Methodology of Architecture Decision, Quality Attributes.

UNIT IV **9**

Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA-Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT V **9**

Aspect Oriented Architectures- AOP in UML, AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to explain the need, design approaches for software architecture to bridge the dynamic requirements and implementation	
CO2	Students will be able to apply the design principles for large scale systems	
CO3	Students will be able to design the architectures for distributed heterogeneous systems ,environment through brokerage interaction.	
CO4	Students will able to demonstrate the concepts of service oriented and model driven architectures.	
CO5	Students will be able to develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.	

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERCENCES:

1. Essentials of software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010

CP22009 **LANGUAGE TECHNOLOGIES**

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the fundamentals of Natural Language Processing (NLP)
- To learn the modern algorithms of speech recognition and speech synthesis
- To appreciate the use of CFG and PCFG in NLP
- To understand the role of semantics and pragmatics
- To understand the process of IE to populate the contents of relational database

UNIT I INTRODUCTION **9**

Words - Regular Expressions and Automata - Words and Transducers - N-grams – Part-of-Speech – Tagging - Transformation based tagging- Evaluation and Error Analysis- Advanced Issues in Part of Speech Tagging- Hidden Markov and Maximum Entropy Models.

UNIT II SPEECH **9**

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition - Advanced Topics -Speech Recognition by humans–Spell Checking and Information Extraction - Computational Phonology.

UNIT III SYNTAX **9**

Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity

UNIT IV SEMANTICS AND PRAGMATICS **9**

The Representation of Meaning - Computational Semantics –Syntax Driven Semantic Analysis – Unification based approaches to Semantic Analysis - Lexical Semantics - Computational Lexical Semantics –Unsupervised sense disambiguation- Computational Discourse- Coreference Resolution.

UNIT V APPLICATIONS **9**

Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents Markov Decision Process Architecture - Machine Translation(MT)- MT Evaluation - Syntactic Models for MT.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to describe a given text with basic Language features.	**1**
CO2	Students will be able to clarify an innovative application using NLP components.	**2**
CO3	Students will be able to implement a rule-based system to tackle morphology/syntax of a language.	**3**
CO4	Students will be able to identify a tag set to be used for statistical processing for real time applications.	**4**
CO5	Students will be able to compare and contrast use of different statistical approaches for different types of NLP applications.	**2**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.
2. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.

REFERCENCES:

1. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
2. Richard M Reese, "Natural Language Processing with Java", O_Reilly Media, 2015.
3. Steven Bird, Ewan Klein and Edward Loper, -"Natural Language Processing with Python", First Edition, O_Reilly Media, 2009.

CP22011 **WEB ANALYTICS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the Web analytics platform, and their evolution.
- To learn about the various Data Streams Data.
- To learn about the benefits of surveys and capturing of data
- To understand Common metrics of web as well as KPI related concepts.
- To learn about the various Web analytics versions

UNIT I INTRODUCTION **9**

Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, on site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.

UNIT II DATA COLLECTION **9**

Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

UNIT III QUALITATIVE ANALYSIS **9**

Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

UNIT IV WEB METRICS **9**

Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs

UNIT V WEB ANALYTICS 2.0 **9**

Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Understand the Web analytics platform, and their evolution.	**2**
CO2	Use the various Data Streams Data.	**2**
CO3	Know how the survey of capturing of data will benefit.	**3**
CO4	Understand Common metrics of web as well as KPI related concepts.	**2**
CO5	Apply various Web analytics versions in existence.	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed, 2012.

REFERCENCES:

1. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed, 2010
2. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons, 2002

CP22013 **NEXT GENERATION NETWORKS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the technical, economic and service advantages of next generation networks.
- To learn the evolution of technologies of 4G and beyond.
- To learn Software defined Mobile Network issues and integrating challenges with LTE.
- To explore the NGN framework, developments catering the services of end user with QoS provisioning.
- To learn about the NGN management and standards.

UNIT I INTRODUCTION **9**

Evolution of public mobile services -Motivations for IP based services, Wireless IP Network Architecture –3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, NGN Networks: Perspectives – Potentials - Advances

UNIT II 4G AND BEYOND **9**

Introduction to LTE- Requirements and Challenges, Network Architectures –EPC, E-UTRAN Architecture - Mobility Management, Resource Management, Services, Channel -Logical and Transport Channel Mapping, Downlink/Uplink data transfer, MAC control element, PDU packet formats, Scheduling Services, Random Access Procedure.

UNIT III SDMN-LTE INTEGRATION **9**

SDN Paradigm and Applications, SDN for Wireless - Opportunities and Challenges, Leveraging SDN for 5G Networks - NFV, Ubiquitous connectivity, Mobile Clouds, Cooperative Cellular Networks - Restructuring Mobile Networks to SDN-SDN/LTE Integration Benefits.

UNIT IV NGN ARCHITECTURE **9**

NGN Requirements on Technology – Real-time Communication, Virtual Environment, NGN functional architecture- Transport stratum, Service stratum, Service/ Application/ Content Layer and Customer Terminal Equipment function. NGN entities, Network and Service evolution - fixed, mobile, cable and internet evolution towards NGN, NGN Key Development Areas – terminal , access network, core transport network, service creation area

UNIT V NGN MANAGEMENT AND STANDARDIZATION **9**

NGN requirements on Management-Customer, Third-party, Device, Configuration, Accounting,

Performance, Device and Information management. Service and control management- End-toEnd QoS and security. ITU and GSI-NGN releases, ETSI-NGN concept and releases, NGMN alliance and NGMN.

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Students will be able to identify the issues and challenges of wireless domain in future generation network design.	**2**
CO2	Students will be able to infer the LTE concepts and technologies	**2**
CO3	Students will be able to illustrate the need for evolution of NGN management and standardizations.	**3**
CO4	Students will be able to discover SDN Wireless challenges and explore restructuring networks for integrating 5G connectivity	**2**
CO5	Students will be able to formulate the performance metrics in managing NGN architecture	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, January 2008.
2. Madhusanga Liyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015

REFERCENCES:

1. Martin Sauter,"3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.
2. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
3. Thomas Plavyk, ―Next generation Telecommunication Networks, Services and Management‖, Wiley & IEEE Press Publications, 2010.

CP22015 **DEVOPS AND MICROSERVICES**

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the basic concepts and terminology of DevOps
- To gain knowledge on Devops platform
- To understand building and deployment of code
- To be familiar with DevOps automation tools
- To learn basics of MLOps

UNIT I INTRODUCTION **9**

Software Engineering - traditional and Agile process models - DevOps -Definition - Practices - DevOps life cycle process - need for DevOps –Barriers

UNIT II DEVOPS PLATFORM AND SERVICES **9**

Cloud as a platform - IaaS, PaaS, SaaS - Virtualization - Containers –Supporting Multiple Data Centers - Operation Services - Hardware provisioning- software Provisioning - IT services - SLA - capacity planning - security - Service Transition - Service Operation Concepts.

UNIT III BUILDING , TESTING AND DEPLOYMENT **9**

Microservices architecture - coordination model - building and testing - Deployment pipeline - Development and Pre-commit Testing -Build and Integration Testing - continuous integration - monitoring - security - Resources to Be Protected - Identity Management

UNIT IV DEVOPS AUTOMATION TOOLS **9**

Infrastructure Automation- Configuration Management - Deployment Automation - Performance Management - Log Management -Monitoring

UNIT V MLOPS **9**

MLOps - Definition - Challenges -Developing Models - Deploying to production - Model Governance - Real world examples

TOTAL : 45 PERIODS

OUTCOMES:

CO	CO statements Upon successful completion of the course, the students should be able to	RBT Level
CO1	Implement modern software Engineering process	**2**
CO2	Work with DevOps platform	**2**
CO3	Build, test and deploy code	**3**
CO4	Explore DevOps tools	**2**
CO5	Correlate MLOps concepts with real time examples	**3**

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

TEXT BOOKS:

1. Len Bass, Ingo Weber and Liming Zhu, —"DevOps: A Software Architect's Perspective", Pearson Education, 2016

REFERCENCES:

1. Joakim Verona - "Practical DevOps" - Packet Publishing , 2016
2. Viktor Farcic -"The DevOps 2.1 Toolkit: Docker Swarm" - Packet Publishing, 2017
3. Mark Treveil, and the Dataiku Team-"Introducing MLOps" - O'Reilly Media- 2020