Sri SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

M.E. COMPUTER SCIENCE & ENGINEERING

AUTONOMOUS

REGULATIONS 2020

Academic Year 2020-21 onwards

PG CURRICULUM AND SYLLABUS I - IV SEMESTERS

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

QUALITY POLICY

We at Sri Sai Ram Engineering College are committed to build a better Nation through Quality Education with team spirit. Our students are enabled to excel in all values of Life and become Good Citizens. We continually improve the System, Infrastructure and Service to satisfy the Students, Parents, Industry and Society.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VISION

To excel in the field of Computer Science and contribute to the research, shaping Technical professionals to outshine as entrepreneurs and enable the students to serve as a valuable resource for industry and society.

MISSION

Department of Computer Science & Engineering, Sri Sairam Engineering College is committed to

M1 To provide good infrastructure and teaching learning ambience

M2 To instil in the students to pursue careers in industry, academic, research through life-long learning and encourage entrepreneurship skills among students.

M3 To facilitate the development of academia-industry collaboration programs to meet the changing needs of society.

M4 To provide mentoring to the students in order to excel in their chosen field.

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20PCSMA104	Applied Probability and Statistics	4	0	0	4	4
2	20PCSPC101	Advanced Data Structures and Algorithms	3	0	0	3	3
3	20PCNPC101	Advanced Computer Architecture	3	0	0	3	3
4	20PCSPC102	Advanced Databases	3	0	0	3	3
5	20PCSPW101	Advanced Machine Learning (with Laboratory)	2	0	2	4	3
PRACTICAL							
6	20PCSPL101	Data Structures Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - I							
7	20PCSTE101	Innovative Design Project - I	0	0	4	4	2
TOTAL						**24**	**19.5**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20PCSPC201	Network Design and Technologies	3	0	0	3	3
2	20PCSPC202	Security Practices	3	0	0	3	3
3	20PCSPC203	Cloud Computing Technologies	3	0	0	3	3
4	20PCSPC204	Big Data Analytics	3	0	0	3	3
5	20PXXELXXX	Professional Elective – I	3	0	0	3	3
PRACTICAL							
6	20PCSPL201	Data Analytics Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - II							
7	20PCSTE201	Innovative Design Project - II	0	0	4	4	2
TOTAL						**22**	**18.5**

SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20PXXELXXX	Professional Elective-II	3	0	0	3	3
2	20PXXELXXX	Professional Elective-III	3	0	0	3	3
3	20PXXELXXX	Professional Elective-IV	3	0	0	3	3
PRACTICAL							
4	20PCSPJ301	Project Work Phase - I	0	0	12	12	6
TOTAL						**21**	**15**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
PRACTICAL							
1	20PCSPJ401	Project Work Phase - II	0	0	24	24	12
TOTAL						**24**	**12**

PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	20PCSEL201	R Programming	3	0	0	3	3
2	20PCSEL202	Parallel Programming Paradigms	3	0	0	3	3
3	20PCSEL203	Information Retrieval Techniques	3	0	0	3	3
4	20PCNEL201	Image Processing and Analysis	3	0	0	3	3
5	20PCNEL207	Software Architecture and Design	3	0	0	3	3
6	20PCNEL209	Mobile and Pervasive Computing	3	0	0	3	3

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	20PCSEL301	Performance Analysis of Computer Systems	3	0	0	3	3
2	20PCSEL302	Web Engineering	3	0	0	3	3
3	20PCSEL303	Service Oriented Architecture and Design	3	0	0	3	3
4	20PCSEL304	Speech Processing and Synthesis	3	0	0	3	3
5	20PCSEL305	Software Quality Assurance and Testing	3	0	0	3	3
6	20PCSEL306	Block Chain Technology	3	0	0	3	3

PROFESSIONAL ELECTIVES - III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	20PCSEL307	Formal Models of Software Systems	3	0	0	3	3
2	20PCSEL308	Embedded Software Development	3	0	0	3	3
3	20PCSEL309	Bio-Inspired Computing	3	0	0	3	3
4	20PCSEL310	Compiler Optimization Techniques	3	0	0	3	3
5	20PCSEL311	Internet of Things	3	0	0	3	3
6	20PCNEL306	Social Network Analysis	3	0	0	3	3

PROFESSIONAL ELECTIVES - IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	20PCSEL312	Data Visualization Techniques	3	0	0	3	3
2	20PCSEL313	Reconfigurable Computing	3	0	0	3	3
3	20PCSEL314	Mobile Application Development	3	0	0	3	3
4	20PCSEL315	Bio Informatics	3	0	0	3	3
5	20PCNEL308	Information Storage Management	3	0	0	3	3
6	20PCNEL311	Ethical Hacking	3	0	0	3	3

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 To enable Graduates to pursue research, or have a successful career in academia or industries associated with Computer Science and Engineering, or as entrepreneurs.

PEO2 To provide Graduates with strong foundational concepts and also advanced techniques, tools in order to enable them to build solutions or systems of varying complexity in diverse career paths including supportive and leadership roles on multidisciplinary teams.

PEO3 To prepare Graduates to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

PEO4 To make the Graduates to acquire professional integrity, ethics of research and an understanding of responsibility to contribute to the community for sustainable development of society.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 To analyze, design and develop computing solutions by applying foundational / advanced concepts of Computer Science and Engineering.

PSO2 To apply Software Engineering principles and practices for developing quality software for scientific and business applications and to adopt emerging Information and Communication Technologies (ICT) to innovate ideas and solutions to existing/novel problems.

PROGRAMME OUTCOMES(POs)

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and Sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SEMESTER - I

20PCSMA104 SDG NO. 4	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To introduce the basic concepts of probability, one dimensional random variable and some standard discrete and continuous distributions.
- To gain knowledge in two dimensional random variables, correlation and regression and functions of random variables.
- To provide the basic principles of the theory of estimation and apply it in engineering problems.
- To formulate and test hypothesis based on Normal, t, F and Chi squared distributions.
- To introduce the concepts and principles of multivariate data analysis for analysing multi variate data sets.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability Axioms of probabilityConditional probability - Random variables - Probability functionMoments Moment generating functions and their properties Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributionsFunction of a random variable.

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 momentsMaximum 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 - Small and large samples - Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions - Tests for independence of attributes and goodness of fit.

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: 60 PERIODS

REFERENCES:

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2014.
2. Dallas E. Johnson, "Applied Multivariate Methods for Data Analysis", Thomson and Duxbury Press, 1998.
3. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan and Sons, New Delhi, 2001.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 5th Edition, Pearson Education, Asia, 2002.

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Apply basic probability axioms, moments of discrete and continuous random variables, discrete and continuous distributions in solving engineering problems.
2. Compute the coefficients of correlation, regression and the joint probability density function of transformation of random variables.
3. Calculate the consistency, efficiency and unbiasedness of estimators using the method of maximum likelihood estimation, fit a curve by the method of least squares and find the regression lines.
4. Use statistical tests in testing hypotheses on data.
5. Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	1
CO2	3	3	3	2	-	-	-	-	-	-	-	1
CO3	3	3	3	2	-	-	-	-	-	-	-	1
CO4	3	3	3	2	-	-	-	-	-	-	-	1
CO5	3	3	3	2	-	-	-	-	-	-	-	1

SEMESTER - I

20PCSPC101 SDG NO. 4 & 9	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the usage of algorithms in computing and to choose appropriate data structures for solving problems.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING 9

Algorithms – Algorithms as a technology- Insertion Sort – 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 B-Trees – 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 10

Elementary Graph Algorithms: 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; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm.

UNIT IV ALGORITHM DESIGN TECHNIQUES 8

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 COMPLETE AND NP HARD 9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems, NP Hard Problems.

TOTAL: 45 PERIODS

REFERENCES:

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.
3. S.Sridhar,"Design and Analysis of Algorithms", First Edition, Oxford University Press. 2014.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein,"Introduction to Algorithms", Third Edition, Prentice-Hall, 2011.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_cs10/preview
2. https://courses.csail.mit.edu/6.851/spring12/lectures/
3. https://nptel.ac.in/courses/106102064/
4. https://www.edx.org/course/algorithmic-design-and- techniques

ONLINE RESOURCES:

1. https://freevideolectures.com/course/1941/introduction-to algorithms
2. https://youtu.be/gTK9EfE7jQQ
3. http://www2.cs.uregina.ca/~mouhoubm/=postscript/=c3620/ chap10.pdf

OUTCOMES:

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

1. Identify suitable data structures and develop algorithms to solve computing problems.
2. Develop and analyze algorithms for hierarchical data structures.
3. Design algorithms using graph structure to solve real-life problems.
4. Develop various string matching algorithms.
5. Apply suitable design strategy for problem solving.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	33	3	3	3	1	1	1	-	1	1	1	3	3	2
CO2	3	2	3	2	-	-	-	-	-		1	2	3	2
CO3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	2	1	1	-	-	-	-	1	2	3	2
CO5	3	3	3	3	1	1	1	1	1	1	1	3	3	2

SEMESTER - I

20PCNPC101 SDG NO. 4	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the recent trends in the field of Computer Architecture and identify performance related parameters
- To learn different multiprocessor issues
- To expose different types of multicore architectures
- To understand the design of the memory hierarchy

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP - Multithreading.

UNIT II MEMORY HIERARCHY DESIGN 9

Introduction – Optimizations of Cache Performance – Memory Technology

and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT III MULTIPROCESSOR ISSUES 9

Introduction - Centralized, Symmetric and Distributed Shared Memory Architectures - Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study- Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

UNIT IV MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers Architectures- Physical Infrastructure and Costs-Cloud Computing –Case Study- Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

TOTAL: 45 PERIODS

REFERENCES:

1. David B. Kirk, Wen-mei W. Hwu, Morgan Kauffman, "Programming Massively Parallel Processors", 2010.
2. Darryl Gove, "Multicore Application Programming: For Windows, Linux, and Oracle Solaris", Pearson, 2011.
3. David E. Culler, Jaswinder Pal Singh, "Parallel computing architecture : A hardware/software approach" , Morgan Kaufmann /Elsevier Publishers, 1999.
4. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier, 5th edition, 2012.
5. Kai Hwang and Zhi.Wei Xu, "Scalable Parallel Computing", Tata McGraw Hill, NewDelhi, 2003.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_cs62/
2. http://cs.baylor.edu/~maurer/aida/courses/archintro.pdf

OUTCOMES:

Upon completion of this course, the students should be able to

1. Discuss the limitations of ILP.

2. Understand the different multiprocessor and its real time applications
3. Identify issues related to multiprocessing and suggest solutions
4. Illustrate various techniques used in multicore architecture
5. Understand Vector,SIMD and GPU architecture

CO-PO,PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	2	2	2	3	1	2
CO2	3	3	3	2	2	2	-	-	2	2	2	3	1	2
CO3	3	3	3	2	2	2	-	-	2	2	2	3	1	2
CO4	3	3	3	2	2	2	-	-	2	2	2	3	1	2
CO5	3	3	3	2	2	2	-	-	2	2	2	3	1	2

SEMESTER - I

20PCSPC102 SDG NO. 4	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- To understand the emerging databases like Mobile, XML and Multimedia.

UNIT I PARALLEL AND DISTRIBUTED DATABASES 9

Introduction to Databases- Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism –Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies.

UNIT II INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics (Starburst, Oracle, Db2)- Taxonomy Applications- Design Principles for Active Rules- Temporal Databases:

Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL- Spatial Databases- Spatial Data Types - Spatial Relationships-Spatial Data Structures-Spatial Access Methods- Spatial DB Implementation.

UNIT III XML DATABASES 9

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

UNIT IV MOBILE DATABASES 9

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols

UNIT V MULTIMEDIA DATABASES 9

Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass,V.S.Subrahmanian, Roberto Zicari, "Advanced Database Systems", Morgan Kaufmann publishers,2006.

REFERENCES:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2011.
2. Vijay Kumar, "Mobile Database Systems", John Wiley & Sons, 2006.
3. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition , Pearson, 2011.
4. Thomas Cannolly and Carolyn Begg,"Database Systems, A Practical Approach to Design, Implementation and Management", Fourth Edition, Pearson Education, 2008.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_cs03/preview
2. https://nptel.ac.in/courses/106/104/106104135/

ONLINE RESOURCES:

1. https://www.edx.org/learn/databases

2. https://freevideolectures.com/course/3752/advanced-database-systems

OUTCOMES :

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

1. Develop skills on databases to optimize their performance in practice.
2. Analyze each type of databases and its necessity
3. Design faster algorithms in solving practical database problems
4. Analyze mobile databases and various transaction models.
5. Gain knowledge about multimedia databases and its applications.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	1	1	2	2	2	2
CO2	3	3	2	-	-	-	-	-	1	1	2	2	2	2
CO3	3	3	2	1	-	-	-	-	2	2	3	3	3	3
CO4	3	3	3	1	2	-	-	-	3	3	3	3	3	3
CO5	3	3	3	2	2	-	-	-	3	3	3	3	3	3

SEMESTER - I

20PCSPW101 SDG NO. 4 & 9	ADVANCED MACHINE LEARNING (WITH LABORATORY)	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the basic concepts and techniques of Machine Learning.
- To implement the concepts of Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques
- To understand graphical models of machine learning algorithms

UNIT I INTRODUCTION **9**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Regression.

UNIT II LINEAR AND GRAPHICAL MODEL 9

Multi-layer Perceptron –Deriving Back-Propagation– Radial Basis Functions and Splines – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines- Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution - Graphical Models –Bayesian Networks – Markov Random Fields – Hidden Markov Models.

UNIT III TREE AND PROBABILISTIC MODELS 9

Learning with Trees – Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms –Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

UNIT V LAB COMPONENT – LIST OF EXPERIMENTS 9

1. Demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
3. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
4. Apply k-Means algorithm to cluster a set of data stored in a .CSV file and comment on the quality of clustering.
5. Interpret the results of PCA analysis .
6. Implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets..

TOTAL: 45 PERIODS

TEXT BOOK:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2013.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press,2014
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
4. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.

WEB REFERENCES:

1. http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012.
2. http://www.amazon.com/Machine-Learning-Algorithmic-Perspective-Recognition/dp/1420067184
3. http://research.microsoft.com/en-us/um/people/cmbishop/prml/
4. http://www.cs.cmu.edu/~tom/mlbook.html

ONLINE RESOURCES:

1. http://calla.rnet.missouri.edu/cheng_courses/mlbioinfo/heckerman_bn.pdf
2. https://link.springer.com/chapter/10.1007/3-540-26888-X_5

DATASETS:

Data sets can be taken from standard repositories

- SNAP: Stanford Large Network Dataset Collection
- The UCI Machine Learning Repository
- The UCI Network Data Repository
- The Koblenz Network Collection

Or constructed by the students.

OUTCOMES:

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

1. Understand the concept of machine learning fundamentals
2. Apply the appropriate machine learning strategy for linear and graphical model

3. Apply the tree and probabilistic approach in learning
4. Analyze the evolutionary model in machine learning
5. Design and develop machine learning applications using the following Tools : SAS / NumPy, Software: Weka, TensorFlow, RapidMiner.

CO- PO,PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	3	1	1	2	1	2	3	3
CO2	2	2	3	2	2	-	2	-	1	-	-	-	3	3
CO3	2	3	2	2	2	-	2	2	-	-	1	-	2	2
CO4	3	2	2	3	2	-	3	1	-	2	1	2	2	2
CO5	3	2	2	3	2	1	2	1	1	2	1	2	3	3

SEMESTER - I

20PCSPL101 SDG NO. 4 & 9	DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.
- To learn about Huffman Coding

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
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation

TOTAL: 45 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

Hardware Requirements:

- Desktop Systems - Pentium IV with 2 GB RAM
- 160 GB HARD Disk
- Monitor 1024 x 768 color

Software Requirements:

- Windows Operating System.
- Dev C++/C/Equivalent Compiler.
- JDK 1.8

OUTCOMES:

Upon Completion of this course, the students should be able to

1. Design and implement basic data structures.
2. Implement advanced data structures extensively
3. Design algorithms using graph structures.
4. Design and develop efficient algorithms with minimum complexity using design techniques.
5. Understand and develop Dynamic programming algorithms.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	2	1	-	1	3	3	1	1	3	2
CO2	3	3	3	3	2	-	1	1	3	2	1	1	3	2
CO3	3	2	3	2	3	1	-	-	2	2	2	-	3	2
CO4	3	3	3	3	3	1	1	1	3	3	2	1	3	2
CO5	3	3	3	3	3	1	1	-	3	3	2	1	3	2

SEMESTER - I

20PCSTE101 SDG NO. 4 & 9	INNOVATIVE DESIGN PROJECT - I	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To encourage in identifying problems with social relevance
- To think of an innovative solution for the problem
- To design and conduct suitable experiment with modern tool
- To develop a cost effective prototype of the innovative design

- To understand the practical aspects and associated challenges in implementing the design

METHODOLOGY:

1. Student should do it individually.
2. Student should submit / present his/her ideas to the Faculty-in-Charge for approval.
3. Student should submit proposal with system/ technical details and cost implications.
4. Student should periodically demonstrate his/her progress.

EVALUATION: Evaluation will be based on:

1. The social relevance of the work.
2. The utility of the system developed.
3. The Level of proof of concept.
4. Industry support if obtained.etc.

WEB REFERENCES:

1. https://www.mathworks.com/academia/books.html
2. http://www.mathcs.emory.edu/~cheung/Courses/455/Syllabus/A3-NS/Book/Introduction-to- Network-Simulator-NS2-2012.pdf

ONLINE REFERENCES

1. http://www.jgyan.com/ns2/
2. https://matlabacademy.mathworks.com/

OUTCOMES:

Upon completion of the course, the student should be able to

1. The student would be able to identify socially relevant issues and apply his/her knowledge to evolve feasible solutions.
2. The student would be able to comprehensively record and report the measured data, write reports, communicate research ideas and do oral presentations effectively.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	2	1	3	2	3	3
CO2	3	3	3	3	3	1	1	1	2	1	3	2	3	3

SEMESTER - II

20PCSPC201 SDG NO. 4 & 9	NETWORK DESIGN AND TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principles required for network design.
- To explore various technologies in the wireless domain.
- To study about 3G and 4G cellular networks.
- To understand the paradigm of Software Defined Network.

UNIT I NETWORK DESIGN 10

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to End semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks and Distribution networks.

UNIT II WIRELESS NETWORKS 9

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security– IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles.

UNIT III CELLULAR NETWORKS 9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface –UTRAN –Core and Radio Network Mobility Management – UMTS Security.

UNIT IV 4G NETWORKS 9

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture –Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols –Green Wireless Networks – Physical Layer and Multiple Access – Channel Modeling for 4G –Introduction to 5G.

UNIT V SOFTWARE DEFINED NETWORKS 8

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types– Virtualization – Data Plane – I/O – Design of SDN Framework.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Erik Dahlman, Stefan Parkvall, Johan Skold, "4G: LTE/LTE-Advanced for Mobile Broadband", Academic Press, 2013.
2. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kauffman, 2014.
3. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.

REFERENCES:

1. Larry Peterson and Bruce Davie,"Computer Networks: A Systems Approach", 5th edition,Morgan Kauffman, 2011.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
3. Martin Sauter,"Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0", Wiley, 2009.
4. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, "Next-Generation Wireless Technologies", Springer, 2013.
5. Savo G Glisic, "Advanced Wireless Networks – 4G Technologies", John Wiley & Sons,2007.
6. Thomas D.Nadeau and Ken Gray, "SDN – Software Defined Networks", O.Reilly Publishers,2013.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee48/preview
2. https://www.coursera.org/learn/sdn
3. https://www.udemy.com/course/sdn-openflow-nfv-introduction/

ONLINE RESOURCES:

1. https://www3.nd.edu/~mhaenggi/NET/wireless/4G/
2. https://www.cs.vu.nl/~ast/CN5/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Identify the components required for designing a network.
2. Design a network at high-level using different networking technologies.
3. Analyze the various protocols of wireless and cellular networks.

4. Discuss the features of 4G and 5G networks.
5. Experiment with Software Defined Networks.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	2	2	1	1	1	1	2	2	3	2
CO2	2	1	2	2	2	2	2	2	1	1	2	2	3	2
CO3	2	1	2	2	2	2	2	2	1	1	2	2	3	2
CO4	2	1	2	2	2	2	2	1	1	1	1	2	3	2
CO5	2	1	2	2	2	2	1	1	1	1	1	2	3	2

SEMESTER - II

20PCSPC202 SDG NO. 4	SECURITY PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security, Encryption, Privacy, Storage security and related issues.

UNIT I SYSTEM SECURITY 9

Building A Secure Organization- A Cryptography Primer- Detecting System - Intrusion Preventing System - Intrusion- Fault Tolerance and Resilience in Cloud Computing Environments- Security Web Applications, Services and Servers.

UNIT II NETWORK SECURITY 9

Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security Optical Network Security- Optical wireless Security.

UNIT III SECURITY MANAGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and

User Management System - Intrusion and Detection and Prevention System.

UNIT IV CYBER SECURITY AND CRYPTOGRAPHY 9

Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption- Satellite Encryption - Password based authenticated Key establishment Protocols.

UNIT V PRIVACY AND STORAGE SECURITY 9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- Privacy and Security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk Management - Physical Security Essentials.

TOTAL: 45 PERIODS

REFERENCES:

1. John R.Vacca, "Computer and Information Security Handbook", Second Edition, Elsevier 2017.
2. Michael E. Whitman, Herbert J. Mattord," Principal of Information Security, Fourth Edition", Cengage Learning, 2018.
3. Richard E.Smith, "Elementary Information Security", Second Edition, Jones and Bartlett Learning, 2016

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106129/
2. https://swayam.gov.in/nd2_cec20_cs09/preview

ONLINE RESOURCES:

1. https://www.coursera.org/learn/international-security-management
2. https://www.learndirect.com/course/security-management
3. https://study.com/articles/Online_Security_Management_Certificate_Programs_and_Courses.html

OUTCOMES:

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

1. Understand the core fundamentals of system security
2. Apply the security concepts related to networks in wired and wireless scenario
3. Implement and manage the security essentials in IT Sector
4. Explain the concepts of Cyber Security and Encryption Concepts
5. Attain a thorough knowledge in the area of Privacy, Storage security and related issues.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	1	1	1	2	3	2
CO2	3	3	3	3	3	3	3	3	1	1	1	2	3	2
CO3	3	3	3	3	3	3	3	3	1	1	1	2	3	2
CO4	3	3	3	3	3	3	3	3	1	1	1	2	3	2
CO5	3	3	3	3	3	3	3	3	1	1	1	2	3	2

SEMESTER - II

20PCSPC203 SDG NO. 4 & 9	CLOUD COMPUTING TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization
- To understand and deploy practical virtualization solutions and enterprise solutions
- To understand the security issues in the grid and the cloud environment

UNIT I VIRTUALIZATION **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

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 structure – 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.

UNIT IV PROGRAMMING MODEL 9

Introduction to Hadoop Framework - MapReduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing MapReduce Applications - Design of Hadoop File System –Setting up Hadoop Cluster - Cloud Software Environments - Eucalyptus, OpenNebula, OpenStack, Nimbus.

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.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

REFERENCES:

1. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
3. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner‟s Guide", McGraw-Hill Osborne Media, 2009.
4. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O'Reilly Media, Inc.,2009.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
6. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105167/
2. https://swayam.gov.in/nd1_noc20_cs20/preview

ONLINE RESOURCES:

1. https://www.ubuntupit.com/best-cloud-computing-books-available-online/
2. https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/
3. https://www.simplilearn.com/what-is-cloud-computing-article
4. https://www.youtube.com/watch?v=_fGrYN5rxhs
5. https://cutepooji.files.wordpress.com/2017/01/distributed-and-cloud-computing-from-parallel-processing-to-the-internet-of-things.pdf

OUTCOMES:

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

1. Employ the concepts of storage virtualization, network virtualization and its management
2. Apply the concept of virtualization in the cloud computing
3. Identify the architecture, infrastructure and delivery models of cloud computing
4. Develop services using Cloud computing
5. Apply the security models in the cloud environment

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	2	1	1	1	-	-	1	1	3	2
CO2	2	1	2	1	3	2	1	1	2	-	1	1	3	2
CO3	3	2	2	3	3	2	1	1	2	1	1	3	3	3
CO4	2	2	3	3	3	1	1	1	3	2	1	3	3	3
CO5	3	2	2	2	3	1	1	1	2	2	1	3	3	3

SEMESTER - II

20PCSPC204 SDG NO. 4 & 9	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the basic concepts of Big Data characteristics and Analytics.
- To examine the Hadoop and MapReduce framework for processing large volume of data sets and various data analysis methods.

- To store and retrieve the data effectively using MongoDB and report generation.
- To analyze the big data for useful business applications and familiar with the Visualization.

UNIT I INTRODUCTION TO BIG DATA ANALYTICS 9

Classification of Digital Data - Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Why Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment - Big Data Analytics: Classification of Analytics – Challenges - Big Data Analytics importance - Data Science - Data Scientist - Terminologies used in Big Data Environments - Soft State Eventual Consistency - Top Analytics Tools.

UNIT II HADOOP AND MAPREDUCE PROGRAMMING 9

Hadoop: Features – Advantages – Versions – Ecosystems – Distributions – Hadoop Versus RDBMS - Distributed Computing Challenges – History - Hadoop Overview - Use Case of Hadoop - Hadoop Distributors - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem – MapReduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.

UNIT III DATA ANALYSIS 9

Statistical Methods: Regression modeling, Multivariate Analysis - Classification: SVM - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Data analysis using R.

UNIT IV NoSQL: MongoDB AND JASPER REPORTS 9

NoSQL Databases: Advantages – Usage – Vendors – New SQL – Comparison of SQL, NoSQL and NewSQL -MongoDB: Why MongoDB - Terms used in RDBMS and MongoDB - Data Types - MongoDB Query Language Methods: Insert – Save – Update – Remove - Find – NULL – Count – Limit – Sort – Skip – Arrays – Aggregate – MapReduce – Cursors in MongoDB – Indexes – Import and Export - JasperReport using Jaspersoft – Connecting to MongoDB, NoSQL Database.

UNIT V FRAMEWORKS AND VISUALIZATION 9

Apache Hbase – Architecture/Storage – Features – Data Model – Shell and Implementation – Hbase vs RDBMS - Zookeeper – Installation and

Configuration - Running Zookeeper - Sqoop – Architecture - Import and Export Data – Sqoop Job – Flume – Log Collection – Working with Twitter Stream - Oozie – Simple and Complex Flow – Components – Service/Scheduler – Workflow – Apache Spark – Lambda Architecture – Spark Streaming – Spark Processing – Apache Kafka – Operations – Visualizations – Visual Data Analysis Techniques – Interaction Techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publications, First Edition, 2015.
2. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, Second Edition, 2007.

REFERENCES:

1. Seema Acharya, "Data Analytics using R", McGraw Hill Publications, New Edition, 2018.
2. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big data for dummies", John Wiley & Sons, Inc., 2013.
3. Tom White, "Hadoop, the Definitive guide", O'Reilly Media, 2010.
4. Donald Miner, "Map Reduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and other Systems", O'Reilly Media, 2012.

WEB REFERENCES:

1. https://www.mongodb.org
2. http://cassandra.apache.org
3. http://apache.bytenet.in/hadoop/common/hadoop-2.6.0
4. https://community.jaspersoft.com

OUTCOMES:

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

1. Identify the characteristics and challenges of big data analytics.
2. Implement the Hadoop and MapReduce framework for processing massive volume of data.
3. Analyze data by utilizing various statistical and data mining approaches.
4. Implement CRUD operations effectively using MongoDB and Report generation using Jaspersoft studio.
5. Explore the usage of Hadoop and its integration tools to manage Big Data and use Visualization Techniques.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	1	3	-	-	-	-	3	-	-	2	2
CO3	3	3	3	3	3	2	-	-	2	3	1	2	3	2
CO4	3	3	3	3	3	2	-	-	2	-	-	-	3	2
CO5	3	3	3	3	3	2	-	-	2	2	2	2	3	2

SEMESTER - II

20PCSPL201 SDG NO. 4 & 9	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To learn to process the big data using Hadoop framework and MapReduce
- To analyze big data using classification and clustering techniques.
- To realize storage of big data using MongoDB and Hbase.
- To develop big data applications for streaming data using Apache Spark.

LIST OF EXPERIMENTS :

1. Install, configure and run Hadoop and HDFS.
2. Implement word count / frequency programs using MapReduce.
3. Implement an MR program that processes a weather dataset.
4. Implement SVM and clustering techniques using R.
5. Visualize data using any plotting framework.
6. Implement an application that stores big data in Hbase / MongoDB using Hadoop / R.
7. Install, deploy and configure Apache Spark cluster. Run an application using Apache Spark.

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

SOFTWARE

Hadoop, R Package, Hbase, MongoDB, Apache Spark

OUTCOMES:

On completion of this laboratory course, the students should be able to

1. Process big data using Hadoop framework.
2. Implement MapReduce framework for processing big data.
3. Perform data analysis using classification and clustering techniques.
4. Realize storage of big data using MongoDB , Hbase and Apache Spark
5. Perform graphical data analysis

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	-	3	-	-	-	-	-	-	-	3	1
CO2	3	3	3	3	3	-	-	-	-	2	-	1	2	2
CO3	1	3	3	3	3	1	-	-	1	2	-	1	1	2
CO4	1	3	3	3	3	1	2	1	1	2	-	1	3	2
CO5	1	1	1	1	3	1	2	1	2	3	-	1	3	2

SEMESTER - II

20PCSTE201 SDG NO. 4 & 9	INNOVATIVE DESIGN PROJECT - II	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To encourage in identifying problems with social relevance
- To think of an innovative solution for the problem
- To design and conduct suitable experiment with modern tool
- To develop a cost effective prototype of the innovative design
- To understand the practical aspects and associated challenges in implementing the design

METHODOLOGY:

1. Student should do it individually.
2. Student should submit / present his/her ideas to the Faculty-in-Charge for approval.

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4. Student should periodically demonstrate his/her progress.

EVALUATION:

Evaluation will be based on:

1. The social relevance of the work.
2. The utility of the system developed.
3. The Level of proof of concept.
4. Industry support if obtained.etc.

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2. http://www.mathcs.emory.edu/~cheung/Courses/455/Syllabus/A3-NS/Book/Introduction-to- Network-Simulator-NS2-2012.pdf

ONLINE REFERENCES:

1. http://www.jgyan.com/ns2/
2. https://matlabacademy.mathworks.com/

OUTCOMES:

Upon completion of the course, the student should be able to

1. The student would be able to identify socially relevant issues and apply his/her knowledge to evolve feasible solutions.
2. The student would be able to comprehensively record and report the measured data, write reports, communicate research ideas and do oral presentations effectively.

CO – PO, PSO MAPPING:

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CO1	3	3	3	3	3	1	1	1	2	1	3	2	3	3
CO2	3	3	3	3	3	1	1	1	2	1	3	2	3	3

SEMESTER - III

20PCSPJ301 SDG NO. 4, 6, 7, 8, 9, 1,12,13, 17	PROJECT WORK PHASE - I	L	T	P	C
		0	0	12	6

OBJECTIVES:

- Identify and describe the problem and scope of project
- Collect, analyze and present data into meaningful information using relevant tools
- Select, plan and execute a proper methodology in problem solving, work independently and ethically
- Present the results in written and oral format effectively and identify basic entrepreneurship skills in project management.

GUIDELINES TO BE FOLLOWED:

A student should work under a project supervisor, a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-I will follow the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Timeline of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 90 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

1. Comprehend and identify an industrial or real life problem with solution.
2. Execute a proper methodology in problem solving
3. Review the literature and design a setup of equipment and complete the analysis
4. Write a project report based on the findings.
5. Demonstrate an ability to present and defend their work to a panel of experts.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - IV

20PCSPJ401 SDG NO. 4, 6, 7, 8, 9, 1,12,13, 17	PROJECT WORK PHASE - II	L	T	P	C
		0	0	24	12

OBJECTIVES:

- Identify and describe the problem and scope of project
- Collect, analyze and present data into meaningful information using relevant tools
- Select, plan and execute a proper methodology in problem solving, work independently and ethically
- Present the results in written and oral format effectively and identify basic entrepreneurship skills in project management.

GUIDELINES TO BE FOLLOWED:

A student should work under a project supervisor, a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the

Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-I will follow the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Timeline of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 90 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

1. Comprehend and identify an industrial or real life problem with solution.
2. Execute a proper methodology in problem solving
3. Review the literature and design a setup of equipment and complete the analysis
4. Write a project report based on the findings.
5. Demonstrate an ability to present and defend their work to a panel of experts.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2

PROFESSIONAL ELECTIVES - I

20PCSEL201 SDG NO. 4 & 9	R PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand and able to use basic programming concepts
- To automate data analysis, working collaboratively and openly on code
- To know how to generate dynamic documents
- Able to use a continuous test driven development approach

UNIT I INTRODUCTION **9**

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

UNIT II CONTROL STRUCTURES AND VECTORS **10**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

UNIT III LISTS **8**

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

UNIT IV FACTORS AND TABLES **8**

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

UNIT V OBJECT-ORIENTED PROGRAMMING 10

S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Roger D. Peng," R Programming for Data Science ", 2012
2. Norman Matloff,"The Art of R Programming- A Tour of Statistical Software Design", 2011

REFERENCES:

1. Garrett Grolemund, Hadley Wickham,"Hands-On Programming with R: Write Your Own Functions and Simulations" , 1st Edition, 2014
2. Venables , W.N.,and Ripley,"S programming", Springer, 2000.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ma33/preview
2. https://data-flair.training/blogs/object-oriented-programming-in-r/
3. http://www.r-tutor.com/elementary-statistics
4. https://www.tutorialspoint.com/r/

ONLINE RESOURCES:

1. https://www.r-tutor.com/elemntary-statstics
2. https://www.edx.org/learn/r-programming
3. https://www.javatpoint.com/r-tutorial

OUTCOMES:

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

1. Study and use basic fundamental concepts to solve the real world problem using R programming language.
2. Design and implement the solution using scalar, vectors ,matrices and statistical problems in R program.
3. Design and implement the program using data frame ,list to provide the solution for various problem.
4. Study about factors and tables and to solve statistical problems.
5. Minimize and maximize functions ,simulation and visualization and statistical analysis using R.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	-	3	-	-	-	2	1	-	3	3	1
CO2	3	-	1	-	3	-	-	-	2	1	-	3	3	1
CO3	3	-	1	-	3	-	-	-	2	1	-	3	3	1
CO4	3	-	1	-	3	-	-	-	2	1	-	3	3	1
CO5	3	-	1	-	3	-	-	-	2	1	-	3	3	1

PROFESSIONAL ELECTIVES - I

20PCSEL202 SDG NO. 4	PARALLEL PROGRAMMING PARADIGMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the issues in parallel computing.
- To describe distributed memory programming using MPI.
- To understand shared memory paradigm with PThreads and with OpenMP.
- To learn the GPU based parallel programming using OpenCL.

UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING 9

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats- Coordinating processes/ threads- Hybrid model – Shared memory model and Distributed memory model - I/O – Performance of Parallel Programs– Parallel program design.

UNIT II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD-programs – MPI_Send and MPI_Recv – Message matching – MPI- I/O – Parallel I/O – Collective communication – Tree-structured communication - MPI_Reduce – MPI_All reduce, broadcast, scatter, gather, allgather – MPI derived types – Dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm.

UNIT III SHARED MEMORY PARADIGM WITH PTHREADS 9

Basics of threads, Pthreads – Thread synchronization – Critical sections – Busy waiting – Mutex – Semaphores – barriers and condition variables – Read Write locks with examples - Caches, Cache coherence and False sharing – Thread Safety - Pthreads Case study.

UNIT IV SHARED MEMORY PARADIGM: OPENMP 9

Basics OpenMP – Trapezoidal Rule-Scope of variables – reduction clause – Parallel for directive – Loops in OpenMP – Scheduling loops –Producer Consumer problem – Cache issues – Threads safety in OpenMP – Two- body solvers- Tree Search.

UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA 9

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object - Case study- Introduction to CUDA programming

TOTAL: 45 PERIODS

REFERENCES:

1. A.Munshi, B.Gaster, T. G.Mattson, J.Fung, and D.Ginsburg, "OpenCL programming guide, Addison Wesley", 2011
2. M. J. Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
3. Peter S. Pacheco, "An introduction to parallel programming, Morgan Kaufmann", 2011.
4. Rob Farber, "CUDA application design and development, Morgan Haufmann", 2011.

WEB REFERENCES:

1. https://www.sciencedirect.com/topics/computer-science/parallel-programming
2. http://www.cse.iitd.ernet.in/~dheerajb/parallel_paradigms.pdf

ONLINE RESOURCES:

1. https://onlinecourses-archive.nptel.ac.in/noc17_cs39/preview
2. https://nptel.ac.in/courses/106102114
3. https://freevideolectures.com/course/3310/parallel-computing

OUTCOMES:

Upon completion of the course, the student should be able to

1. Identify issues in parallel programming.
2. Develop distributed memory programs using MPI framework.
3. Design and develop shared memory parallel programs using Pthreads.
4. Design and develop shared memory paradigm using OpenMP.
5. Implement Graphical Processing OpenCL programs

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	2	2	-	3	3	-
CO2	3	3	3	3	2	-	-	-	2	2	-	3	3	-
CO3	3	3	3	3	3	-	-	-	2	2	-	3	3	-
CO4	3	3	3	3	3	-	-	-	2	2	-	3	3	-
CO5	3	3	3	3	3	-	-	-	2	3	-	3	3	-

PROFESSIONAL ELECTIVES - I

20PCSEL203 SDG NO. 4	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 get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search.
- To understand the concepts of digital libraries.

UNIT I INTRODUCTION: MOTIVATION 9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval –Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR ––IR Versus Web Search–Components of a Search engine

UNIT II MODELING 9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model

- Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.

UNIT III INDEXING 9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching -Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis –Measuring Effectiveness and Efficiency.

UNIT IV CLASSIFICATION AND CLUSTERING 9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning

UNIT V SEARCHING THE WEB 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

REFERENCES:

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

WEB REFERENCES:

1. http://mrim.imag.fr/User/jean-pierre.chevallet/data/IR%20models.pdf
2. https://dataaspirant.com/2016/09/24/classification-clustering-alogrithms/

ONLINE RESOURCES:

1. https://nlp.stanford.edu/IRbook/pdf/irbookonlinereading.pdf https://youtu.be/Bz0aw4_K8oc
2. https://mitmecsept.files.wordpress.com/2018/05/stefan-bc3bcttcher-charles-l-a-clarke-gordon-v- cormack-information-retrieval-implementing-and-evaluating-search-engines-2010-mit.pdf

OUTCOMES:

Upon Completion of the course, the students should be able to

1. Build an Information Retrieval system using the available tools.
2. Identify and design the various components of an Information Retrieval system.
3. Evaluate the effectiveness of the Information Retrieval system.
4. Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
5. Design an efficient search engine and analyze the Web content structure.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	-	-	2	-	1	2	3	2
CO2	3	2	3	2	3	1	-	1	1	1	1	2	3	2
CO3	3	2	2	2	2	1	-	1	1	-	-	2	3	2
CO4	3	3	3	3	2	1	1	1	1	-	-	2	3	2
CO5	3	3	3	2	3	1	1	1	2	1	1	2	3	2

PROFESSIONAL ELECTIVES - I

20PCNEL201 SDG NO. 4	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Image Processing Concepts and Analysis
- To understand the Image Processing Techniques
- To familiarize the Image Processing Environment and their applications
- To use Image Processing in various applications

UNIT I IMAGE PROCESSING FUNDAMENTALS 9

Introduction – Elements of visual perception - Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – Colour Images and Models - Image Operations – Arithmetic - Logical- Statistical and Spatial Operations.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms - Discrete and Fast Fourier Transform and Discrete Cosine Transform - Spatial Domain - Gray Level Transformations - Histogram Processing - Spatial Filtering – Smoothing and Sharpening. Frequency Domain - Filtering in Frequency Domain – Smoothing and Sharpening Filters – Homomorphic Filtering - Noise Models - Constrained and Unconstrained Restoration Models.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation - Image Morphology - Binary and Gray level Morphology Operations - Erosion-Dilation - Opening and Closing Operations - Distance Transforms - Basic Morphological Algorithms. Features – Textures - Boundary Representations and Descriptions - Component Labeling – Regional Descriptors and Feature Selection Techniques.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image Segmentation - Pixel Based - Edge Based - Region Based Segmentation - Active Contour Models and Level Sets for Medical Image Segmentation - Image Representation and Analysis - Feature Extraction and Representation - Statistical - Shape - Texture - Feature and Statistical Image Classification.

UNIT V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid Body Visualization - Principal Axis Registration - Interactive Principal Axis Registration - Feature Based Registration - Elastic Deformation Based Registration - Image Visualization – 2D Display Methods - 3D Display Methods - Virtual Reality Based Interactive Visualization.

TOTAL : 45 PERIODS

REFERENCES:

1. Rafeal C. Gonzalez, Richard E. Woods,"Digital Image Processing"- 3rd Edition, Pearson, 2008.
2. Alasdair McAndrew, "Introduction to Digital Image Processing with Matlab", Cengage Learning 2011,India.

3. Anil J Jain, "Fundamentals of Digital Image Processing", PHI, 2006.
4. Kavyan Najarian and Robert Splerstor, "Biomedical signals and Image Processing", CRC – Taylor and Francis, New York, 2006.
5. S.Sridhar,"Digital Image Processing", Oxford University Press, 2011.

WEB REFERENCES:

1. http://eeweb.poly.edu/~onur/lectures/lectures.html
2. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
3. https://nptel.ac.in/courses/117105135/
4. https://nptel.ac.in/courses/106105032/

OUTCOMES:

Upon successful completion of this course, a student should be able to

1. Understand the basic concepts of Image Processing.
2. Apply algorithms for Image Processing Applications that incorporate different concepts of Medical Image Processing.
3. Identify the possibility of applying Image Processing concepts in various Applications.
4. Analyze different approaches to Image Processing Applications.
5. Design Image Processing Applications.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	2	1	1	2	3	3
CO2	3	3	3	3	3	1	1	1	2	1	1	2	3	3
CO3	3	3	3	3	3	1	1	1	2	1	1	2	3	3
CO4	3	3	3	3	3	1	1	1	2	1	1	2	3	3
CO5	3	3	3	3	3	1	1	1	2	1	1	2	3	3

PROFESSIONAL ELECTIVES - I

20PCNEL207 SDG NO. 4 & 7	SOFTWARE ARCHITECTURE 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

UNIT I INTRODUCTION TO SOFTWARE ARCHITECTURE 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 OBJECT-ORIENTED PARADIGM 9

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 DISTRIBUTED ARCHITECTURE 9

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 USE CASE AND USER INTERFACE PATTERNS FOR DATA ORIENTED APPLICATIONS 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 ASPECT ORIENTED ARCHITECTURES 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

REFERENCES:

1. Ion Gorton, "Essentials of software Architecture", Second Edition, Springer- Verlag, 2011.
2. "Software Architecture Design Illuminated", Kai Qian Jones and Bartlett Publishers Canada, 2010.
3. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.

WEB REFERENCES:

1. https://cosmolearning.org/courses/software-architecture-design/video-lectures/.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106101061/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the need of software architecture for sustainable dynamic systems.
2. Identify a sound knowledge on design principles and to apply for large scale systems.
3. Ability to design architectures for distributed heterogeneous systems.
4. Develop a good knowledge on service oriented and model driven architectures.
5. Design a good knowledge on aspect oriented architecture.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	I	2	1	2	1	-	-	1	-	3	1	1	I	1
CO2	2	1	1	3	2	-	1	-	-	3	-	2	I	2
CO3	2	3	2	3	3	-	1	3	-	-	2	-	2	2
CO4	2	1	1	1	1	1	-	-	-	3	-	3	1	1
CO5	1	1	2	2	3	1	1	1	-	-	1	1	2	1

PROFESSIONAL ELECTIVES - I

20PCNEL209 SDG NO. 4	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the emerging technologies in the context of wireless networks.
- Understand the mobile computing environment
- Learning the concepts of tracking management schemes wireless mobile networks
- Learn about a pervasive computing environment

UNIT I EMERGING TECHNOLOGIES 9

Wireless networks - Emerging technologies - Bluetooth, WiFi, WiMAX, 3G, WATM. - Mobile IP protocols – WAP push architecture-Wml scripts and applications.

UNIT II MOBILE COMPUTING ENVIRONMENT AND SECURITY 9

Mobile computing environment - Functions -Architecture- Design considerations- Content architecture -CC/PP exchange protocol - Context manager - Data management in WAE- Coda file system- Caching schemes- Mobility QOS - Security in mobile computing.

UNIT III HANDOFF AND TRACKING MANAGEMENT SCHEMES 9

Handoff in wireless mobile networks-Reference model-Handoff schemes- Location management in cellular networks - Mobility models- Location and tracking management schemes- Time, movement, profile and distance based update strategies - ALI technologies.

UNIT IV PERVASIVE COMPUTING **9**

Pervasive Computing- Principles, Characteristics- Interaction transparency - Context aware - Automated experience capture - Architecture for pervasive computing- Pervasive devices - Embedded controls - Smart sensors and actuators -Context communication and access services.

UNIT V OPEN PROTOCOLS AND CONTEXT AWARE SENSOR NETWORKS **9**

Open protocols- Service discovery technologies- SDP, Jini, SLP, UpnP protocols- Data synchronization- SyncML framework - Context aware mobile services -Context aware sensor networks - Addressing and communications – Context aware security.

TOTAL: 45 PERIODS

REFERENCES:

1. Ivan Stojmenovic, "Handbook of Wireless Networks and Mobile Computing", John Wiley & sons Inc, Canada, 2002
2. Asoke K Taukder,Roopa R Yavagal, "Mobile Computing", Tata McGraw Hill Pub Co. , New Delhi, 2005.
3. Seng Loke, "Context-Aware Computing Pervasive Systems" Auerbach Pub., New York, 2007.
4. Uwe Hansmannetl , "Pervasive Computing", Springer, New York, 2001.
5. Frank Adelstein, Sandeep KS Gupta, "Fundamentals of Mobile and Pervasive Computing", Golden Richard, McGraw-Hill 2005.
6. Jochen Burkhardt, "Pervasive Computing: Technology and Architecture of Mobile Internet Applications", Addison-Wesley Professional; 3rd edition, 2007.
7. John Krumm, "Ubiquitous Computing Fundamentals", CRC Press,2010.
8. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions", Wiley, 2009.
9. Jochen Schiller, "Mobile Communications", PHI, Second Edition, 2008.
10. Debashis Saha, "Networking Infrastructure for Pervasive Computing: Enabling Technologies", Kluwer Academic Publisher, Springer; First Edition, 2011.
11. Agrawal and Zeng "Introduction to Wireless and Mobile Systems", Brooks / Cole (Thomson Learning), First Edition, 2006.

WEB REFERENCES:

1. http://nptel.ac.in/courses/108102045/37
2. http://nptel.ac.in/video.php?subjectId=117102062
3. http://nptel.ac.in/video.php?subjectId=117102062.

ONLINE RESOURCES:

1. https://www.morganclaypool.com/toc/mpc/1/1.
2. http://mpc.ece.utexas.edu/research.html.
3. https://www.cs.cmu.edu/~15-821/.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understanding the fundamentals of Wireless Networks and Mobile Computing.
2. Study the basics of Mobile computing environment and security.
3. Learning the concepts of tracking management schemes wireless mobile networks.
4. Apply the concepts of Pervasive Computing.
5. Analyse the open protocols and context aware sensor networks.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	3	-	-	-	-	-	-	-	-	-	1	1
CO2	1	1	2	-	-	-	-	-	-	-	-	-	1	1
CO3	2	-	-	-	3	1	-	-	-	-	-	1	3	2
CO4	-	1	2	-	-	2	-	-	-	-	-	1	1	1
CO5	2	2	2	-	-	3	-	-	-	-	-	3	2	2

PROFESSIONAL ELECTIVES - II

20PCSEL301 SDG NO. 4 & 9	PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the analytical modeling of computer systems and metrics used for performance evaluation
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little's Law and other Operational Laws – Modification for Closed Systems.

UNIT II MARKOV CHAINS AND SIMPLE QUEUES 9

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain– M/M/1.

UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke's Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV REAL-WORLD WORKLOADS 9

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Analytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

UNIT V SMART SCHEDULING IN THE M/G/1 9

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies -Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

TOTAL : 45 PERIODS

REFERENCES:

1. K. S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2001.
2. Krishna Kant, "Introduction to Computer System Performance Evaluation", McGraw-Hill, 1992.
3. Lieven Eeckhout, "Computer Architecture Performance Evaluation Methods", Morgan and Claypool Publishers, 2010.
4. MorHarchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action", Cambridge University Press, 2013.
5. Paul J. Fortier and Howard E. Michel,"Computer Systems Performance Evaluation and Prediction", Elsevier, 2003.
6. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling", Wiley-Interscience, 1991.

WEB REFERENCES:

1. http://www.nptelvideos.in/2012/11/performance-evaluation-of-computer.html

ONLINE RESOURCES:

1. https://www.youtube.com/playlist?list=PLjGG94etKypJEKjNAa1n_1X0bWWNyZcof
2. https://www.coursera.org/learn/algorithms-part1

OUTCOMES :

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

1. Identify the need for performance evaluation and the metrics used for it
2. Distinguish between open and closed queuing networks
3. Apply the operational laws to open and closed systems
4. Use discrete-time and continuous-time Markov chains to model real world systems
5. Develop analytical techniques for evaluating scheduling policies

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	-	-	-	1	-	-	1	2	2	2
CO2	3	3	1	1	-	2	-	1	-	-	1	2	2	2
CO3	3	3	1	2	1	2	-	1	-	-	1	2	2	2
CO4	3	3	1	3	1	1	-	1	-	-	1	2	2	2
CO5	2	3	2	3	2	2	-	1	-	-	1	2	2	2

PROFESSIONAL ELECTIVES - II

20PCSEL302 SDG NO. 4 & 9	WEB ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods
- Be familiar with the testing techniques for web applications

UNIT I INTRODUCTION TO WEB ENGINEERING 9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9

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

UNIT III WEB APPLICATION DESIGN 9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines- Workflow-Preliminaries-Design Steps- Usability- Issues-Information Design- Information Architecture- Structuring- Accessing Information-Navigation Design- Functional Design-WebApp Functionality-Design Process- Functional Architecture- Detailed Functional Design - Case Study on UI Design.

UNIT IV TESTING WEB APPLICATIONS 9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches- Conventional Approaches, Agile Approaches- Testing concepts-Testing Process -Test Scheme- Test Methods and Techniques- Link Testing-Browser Testing-Usability Testing- Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing-Test Automation

UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9

Introduction-Challenges in launching the Web Application-Promoting Web Application- Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to Node JS - Web sockets. Case Study: Evolving Framework.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Roger S. Pressman, David Lowe, "Web Engineering", Tata McGraw Hill Publication, 2007.

REFERENCES:

1. Chris Bates,"Web Programming: Building Internet Applications", Third Edition,Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, "Web Engineering, John Wiley and Sons" Ltd, 2006.
3. Guy W. Lecky-Thompson, "Web Programming, Cengage Learning", 2008.
4. John Paul Mueller, "Web Development with Microsoft Visual Studio 2005", Wiley Dream tech, 2006.

WEB REFERENCES:

1. https://www.elegantthemes.com/blog/tipstricks/learn-web-development-online
2. https://web-engineering.info/
3. https://www.mockplus.com/blog/post/web-design-resource

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/web-design
2. https://nptel.ac.in/courses/106/106/106106222/
3. https://link.springer.com/content/pdf/10.1007/978-3-540-27834-4_64.pdf

OUTCOMES:

On Successful completion of the course, students should be able to:

1. Explain the characteristics of Web applications.
2. Model Web applications.
3. Design Web applications.
4. Test Web applications.
5. Promote Web Project Management

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	3	-	-	3	3	-	2	3	2
CO2	2	2	3	2	2	-	2	-	2	3	2	-	2	3
CO3	3	3	2	-	3	3	-	-	-	-	-	2	2	2
CO4	2	2	2	2	2	2	-	-	-	2	2	2	3	2
CO5	3	3	3	2	2	-	2	-	2	2	1	-	2	3

PROFESSIONAL ELECTIVES - II

20PCSEL303 SDG NO. 4 & 9	SERVICE ORIENTED ARCHITECTURE AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn XML concepts and exposed to build applications based on XML
- To gain knowledge about SOAP, HTTP and UDDI to create web services
- To understand the SOA architecture and principles of Service Oriented Architecture.
- To learn about the role of SOA in J2EE, .NET, Web Services and Cloud Computing architecture services.

UNIT I XML AND WEB SERVICES **9**

XML structure – Elements – Creating Well-formed XML - Name Spaces – Schema Elements, Types, Attributes – XSL Transformations – Parser – Web Services Overview – Architecture.

UNIT II WSDL, SOAP and UDDI **9**

WSDL - Overview Of SOAP – HTTP – XML-RPC – SOAP: Protocol – Message Structure – Intermediaries – Actors – Design Patterns and Faults – SOAP With Attachments – UDDI.

UNIT III SOA BASICS **9**

Roots of SOA – Characteristics of SOA - Comparing SOA to Client-server and Distributed Internet architectures – Anatomy of SOA- How components in an SOA interrelate - Principles of Service Orientation – Service Layers.

UNIT IV SOA in J2EE and .NET **9**

SOA platform basics – SOA support in J2EE – Java API for XML-based web services (JAXWS) - Java architecture for XML binding (JAXB) – Java API for XML Registries (JAXR) - Java API for XML based RPC (JAX-RPC) – JAX-RS SOA support in .NET – ASP.NET web services.

UNIT V CLOUD COMPUTING **9**

Vision of Cloud computing – Cloud Definition – Characteristics and Benefits – Virtualization – Cloud computing Architecture – Cloud Reference Model, Types of Clouds – Cloud Platforms in Industry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Heather Williamson, "XML, The Complete Reference", McGraw Hill Education, 2019.
2. Dan woods and Thomas Mattern, "Enterprise SOA designing IT for Business Innovation", O"REILLY, First Edition, 2018.

REFERENCES:

1. Frank. P. Coyle, "XML, Web Services And The Data Revolution", Pearson Education, 2002
2. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2009.
3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, 2013.
4. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services. An Architect's Guide", Pearson Education, 2009
5. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2008.

WEB REFERENCES:

1. https://link.springer.com/chapter/10.1007/978-3-540-38284-3_5
2. https://www.classcentral.com/course/service-oriented-architecture-9219

ONLINE RESOURCES:

1. https://www.coursera.org/learn/service-oriented-architecture
2. https://www.tutorialspoint.com/soa/index.htm

OUTCOMES:

Upon completion of the course, the student should be able to

1. Know the structure of XML and to design and store data in XML
2. Apply SOAP, HTTP and UDDI services in the web applications.
3. To apply SOA architecture and the underlying design principles for the web Projects
4. Understand the role of SOA in J2EE and .NET.
5. Know the Cloud computing architecture and the types of Clouds

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	2	1	1	2	2	2
CO2	3	3	2	3	-	1	1	-	-	-	-	-	2	1
CO3	3	3	2	3	1	1	1	1	-	1	-	1	3	1
CO4	3	3	2	3	-	1	1	1	-	1	-	-	2	2
CO5	3	3	2	3	1	1	2	2	-	1	-	1	3	2

PROFESSIONAL ELECTIVES - II

20PCSEL304 SDG NO. 4 & 9	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the mathematical foundations needed for speech processing.
- To understand the basic concepts and algorithms of speech processing and synthesis.
- To familiarize the students with the various speech signal representation, coding and recognition techniques.
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING 9

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXT ANALYSIS **9**

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT V TEXT TO SPEECH SYNTHESIS **9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Feature space for speaker recognition-similarity measures-Evaluation of TTS Systems, Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Prentice Hall Signal Processing Series, 1993.

REFERENCES:

1. Joseph Mariani, "Language and Speech Processing", Wiley, 2009.
2. SadaokiFurui, "Digital Speech Processing: Synthesis, and Recognition", Second Edition, (Signal Processing and Communications), Marcel Dekker, 2000.
3. Thomas F.Quatieri, "Discrete-Time Speech Signal Processing", Pearson Education, 2002.
4. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, "Spoken Language Processing – A guide to Theory, Algorithm and System Development", Prentice Hall PTR, 2001.

WEB REFERENCES:

1. https://developers.google.com/web/updates/2014/01/Web-apps-that-talk-Introduction-to-the-Speech-Synthesis-API
2. https://www.sciencedirect.com/topics/neuroscience/speech-processing
3. https://nptel.ac.in/courses/117105145/

ONLINE RESOURCES:

1. https://www.cse.iitb.ac.in/~pjyothi/cs753/index.html
2. https://www.phon.ucl.ac.uk/resource/educational.php
3. https://link.springer.com/chapter/10.1007/978-3-540-49127-9_1

OUTCOMES:

Upon completion of the course, students should be able to

1. Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word
2. Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
3. Justify the use of formant and concatenative approaches to speech synthesis
4. Identify the appropriate approach of speech synthesis depending on the language to be processed
5. Determine the various encoding techniques for representing speech.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	3	-	2	3	-	-	3	2
CO2	3	2	3	2	2	2	-	-	2	3	2	-	2	3
CO3	2	3	3	-	-	2	-	-	-	-	-	-	2	2
CO4	3	2	2	2	2	-	2	-	3	2	2	-	3	2
CO5	3	3	3	-	-	-	2	-	2	2	1	-	2	3

PROFESSIONAL ELECTIVES - II

20PCSEL305 SDG NO. 4 & 9	SOFTWARE QUALITY ASSURANCE AND TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of testing, test planning, design and test team.
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing and execution.
- To learn the software quality assurance, metrics, defect prevention and quality assurance techniques.

UNIT I SOFTWARE TESTING - CONCEPTS, ISSUES AND TECHNIQUES 9

Quality Revolution - Verification and Validation - Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black-Box, Test Planning and design, Test Tools and Automation, Power of Test - Test Team Organization and Management-Test Groups-Software Quality Assurance Group - System Test Team Hierarchy- Team Building.

UNIT II SYSTEM TESTING 9

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration - Built-in Testing- Functional testing - Testing a Function in Context - Boundary Value Analysis, Decision Tables-Acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Tes-. Software Reliability - Fault and Failure, Factors Influencing Software, Reliability Models.

UNIT III SYSTEM TEST CATEGORIES 9

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote system test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. System test execution- Modeling Defects, Metrics for Monitoring Test Execution - Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.

UNIT IV SOFTWARE QUALITY 9

Software quality - People's Quality Expectations, Frameworks and ISO-9126, McCall's Quality Factors and Criteria – Relationship- Quality Metrics- Quality Characteristics - ISO 9000:2000 Software Quality Standard - Maturity models-Test Process Improvement, Testing Maturity Model.

UNIT V SOFTWARE QUALITY ASSURANCE 9

Quality Assurance - Root Cause Analysis, Modeling, Technologies, Standards and Methodologies for Defect prevention - Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using

Fault-trees and Event-trees - Comparing Quality Assurance Techniques and Activities - QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement - Case Study: FSM-Based Testing of Web-Based Applications.

TOTAL: 45 PERIODS

REFERENCES:

1. Kshirasagar Naik, Priyadarshi Tripathy, "Software Testing And Quality Assurance-Theory and Practice", John Wiley & Sons Inc,2008.
2. Jeff Tian, "Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement", John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
3. Daniel Galin, "Software Quality Assurance - From Theory to Implementation" , Pearson Education Ltd UK, 2004.
4. Milind Limaye , "Software Quality Assurance", TMH ,New Delhi, 2011

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_cs71/preview

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3655/software-testing

OUTCOMES:

Upon completion of the course, the student should be able to

1. Perform functional and nonfunctional tests in the life cycle of the Software product.
2. Understand system testing and test execution process.
3. Identify defect prevention techniques.
4. Identify software quality assurance metrics.
5. Apply techniques of quality assurance for typical applications.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	1	3	1	1	1	1	2	3	2
CO2	3	3	3	3	3	1	3		1	1	1	2	3	2
CO3	2	3	3	3	-	-	-	-	-	-	-	1	3	2
CO4	2	3	3	3	-	-	-	-	-	-	-	1	3	2
CO5	3	2	2	2	3	1	3	1	1	1	1	2	3	2

PROFESSIONAL ELECTIVES - II

20PCSEL306 SDG NO. 4 & 9	BLOCKCHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of Blockchain.
- To obtain knowledge about technologies of Blockchain.
- To incorporate the models of Blockchain- Ethereum.
- To learn the models of Hyperledger Fabric.

UNIT I INTRODUCTION 9

Basic Cryptographic primitives used in Blockchain –Secure- Collision-Resistant hash functions - Digital signature - Public key cryptosystems - Zero-knowledge proof systems - Need for Distributed Record Keeping - Modelling faults and adversaries- Byzantine Generals problem - Consensus algorithms and their scalability problems - Why Nakamoto Came up with Blockchain based cryptocurrency.

UNIT II TECHNOLOGIES BORROWED IN BLOCKCHAIN 9

Technologies Borrowed in Blockchain –hash pointers- Consensus- Byzantine Models of fault tolerance- Digital cash etc.- Bitcoin blockchain - Wallet - Blocks - Merkley Tree - hardness of mining - Transaction verifiability - Anonymity - forks - Double spending - Mathematical analysis of properties of Bitcoin - Bitcoin- the challenges and solutions.

UNIT III MODELS FOR BLOCKCHAIN 9

Models f-GARAY model -RLA Model -Proof of Work (PoW) as random oracle - Formal treatment of consistency- Liveness and Fairness - Proof of Stake (PoS) based Chains -Hybrid models (PoW + PoS) - Bitcoin scripting language and their use

UNIT IV ETHEREUM 9

Ethereum -Ethereum Virtual Machine (EVM) -Wallets for Ethereum -Solidity - Smart Contracts - The Turing Completeness of Smart Contract Languages and verification challenges- Using smart contracts to enforce legal contracts- Comparing Bitcoin scripting vs. Ethereum Smart Contracts-Some attacks on smart contracts

UNIT V HYPERLEDGER FABRIC 9

Hyperledger fabric- the plug and play platform and mechanisms in

permissioned block chain - Beyond Cryptocurrency – applications of block chain in cyber security- integrity of information- E-Governance and other contract enforcement mechanisms - Limitations of block chain as a technology and myths vs reality of blockchain technology

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.Shukla,M.Dhawan,S.Sharma,S. Venkatesan "Blockchain Technology: Cryptocurrency and Applications" ,Oxford University Press 2019 .
2. Arvind Narayanan, Joseph Bonneau,Edward Felten,Andrew Miller and Steven Goldfeder, "Bitcoin and cryptocurrency technologies: a comprehensive introduction",Princeton University Press,2016.

REFERENCES:

1. Joseph Bonneau et al, SoK: "Research perspectives and challenges for Bitcoin and cryptocurrency", IEEE Symposium on security and Privacy, 2015
2. J.A.Garay et al, "The bitcoin backbone protocol - analysis and applications", EUROCRYPT 2015,Volume 2.
3. R.Pass et al, "Analysis of Blockchain protocol in Asynchronous networks", EUROCRYPT 2017.
4. Pass et al," Fruitchain- a fair blockchain", PODC 2017

WEB REFERENCES:

1. https://www.nptel.ac.in/courses/106105184/
2. https://www.tutorialspoint.com/blockchain/index.htm

ONLINE RESOURCES:

1. https://medium.com/moatcoin/part-1-blockchain-simplified-notes-nptel-71b876f5d300
2. https://www.javatpoint.com/blockchain-tutorial
3. https://intellipaat.com/blog/tutorial/blockchain-tutorial/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Define and Explain the fundamentals of Blockchain
2. Illustrate the technologies of Blockchain
3. Describe the models of Blockchain
4. Analyze and demonstrate the Ethereum
5. Analyze and demonstrate Hyperledger fabric

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	-	2	-	-	-	-	2	2	3	2
CO2	3	1	1	1	-	2	-	-	-	-	2	2	3	2
CO3	3	1	1	1	-	2	-	-	-	-	2	2	3	2
CO4	3	1	1	1	-	2	-	-	-	-	2	2	3	2
CO5	3	1	1	1	-	2	-	-	-	-	2	2	3	2

PROFESSIONAL ELECTIVES - III

20PCSEL307 SDG NO. 4 & 9	FORMAL MODELS OF SOFTWARE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the goals, complexity of software systems, fundamentals of abstraction and formal systems role of Specification activities and qualities to control complexity.
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems.
- To understand formal specification models based on set theory, calculus and algebra and apply to a case study.
- To learn Z, Object Z and B Specification languages with case studies.

UNIT I SPECIFICATION FUNDAMENTALS 10

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity - Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle - Specification Qualities- Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

UNIT II FORMAL METHODS 8

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction - Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism - Properties of Formal Systems - Consistency - Automata-Deterministic Finite Accepters, State

Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property- Oriented Specification Methods, Model-Based Specification Techniques.

UNIT III LOGIC 9

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction - Predicate Logic - Syntax and Semantics, Policy Language Specification, Knowledge Representation Axiomatic Specification - Temporal Logic - Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL) - Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

UNIT IV SPECIFICATION MODELS 9

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications Case Study—A Multiple Window Environment: Requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency - Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

UNIT V FORMAL LANGUAGES 9

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags - Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations - Additional Features in Z - Case Study: An Automated Billing System - The Object-Z Specification Language- Basic Structure of an Object-Z, Specification - Parameterized Class, Object-Orientation, composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator and Environment Enrichment- The B-Method –Abstract- Machine Notation (AMN), Structure of a B Specification, Arrays, Statements - Structured Specifications, Case Study- A Ticketing System in a Parking.

TOTAL: 45 PERIODS

REFERENCES:

1. M.Ben-Ari, “Mathematical Logic for computer science”, Second Edition, Springer,2003.

2. Logic in Computer Science- Modeling and Reasoning about Systems, 2nd Edition, Cambridge University Press, 2004.
3. V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, "Specification of Software Systems ", Springer –Verlag London, 2011
4. Jonathan Jacky, "The ways Z: Practical Programming with Formal methods", Cambridge University Press,1996.
5. Jim Woodcock and Jim Devies , "Using Z-Specification Refinement and Proof", Prentice Hall,1996.
6. Antoi Diller, "Z: An introduction to formal methods", Second Edition, Wiley, 1994.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/103/111103016/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
2. Gain knowledge on fundamentals of abstraction and formal systems
3. Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
4. Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study
5. Have working knowledge on Z, Object Z and B Specification languages with case studies.

CO- PO,PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	-	1	-	2	3	2
CO2	3	-	-	2	-	-	-	-	-	-	-	1	3	2
CO3	3	2	3	3	2	1	1	1	2	1	1	2	3	2
CO4	3	3	3	3	3	1	1	1	2	-	1	2	3	2
CO5	2	-	2	3	3	1	-	1	1	1	1	1	3	2

PROFESSIONAL ELECTIVES - III

20PCSEL308 SDG NO. 4 & 9	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.

UNIT I EMBEDDED PROCESSORS 9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioral Description - ARM Processor – Intel ATOM Processor.

UNIT II EMBEDDED COMPUTING PLATFORM 9

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT III EMBEDDED NETWORK ENVIRONMENT 9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT IV REAL-TIME CHARACTERISTICS 9

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT V SYSTEM DESIGN TECHNIQUES 9

Design Methodologies - Requirement Analysis - Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples -

Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

TOTAL: 45 PERIODS

REFERENCES:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013
2. Andrew N Sloss, D. Symes, C. Wright, “Arm system developers guide”, Morgan Kauffman/Elsevier, 2006.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on-Approach" VPT First Edition, 2014
4. C. M. Krishna and K. G. Shin, “Real-Time Systems”, McGraw-Hill, 1997
5. Frank Vahid and Tony Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, John Wiley & Sons.
6. Jane.W.S. Liu, “Real-Time systems”, Pearson Education Asia.
7. Michael J. Pont, “Embedded C”, Pearson Education , 2007.
8. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C" Pearson Education, First edition, 2014
9. Steve Heath, “Embedded System Design”, Elsevier, 2005
10. Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117/106/117106112/

ONLINE RESOURCES:

1. https://freevideolectures.com/search/embedded-/
2. https://e-box.co.in/embedded-systems-course.shtml

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand different architectures of embedded processor, microcontroller and peripheral devices interface memory and peripherals with embedded systems.
2. Work with embedded network environment.
3. Understand challenges in Real time operating systems.
4. Design and analyze applications on embedded systems
5. Promoting embedded system

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	-	2	1	-	1	1	2	2	3	2
CO2	2	2	3	1	1	-	-	-	-	-	2	-	2	3
CO3	2	1	2	2	-	2	1	-	1	2	-	2	3	2
CO4	3	2	3	1	3	1	-	1	-	-	2	1	2	3
CO5	3	1	2	2	3	2	-	2	2	3	2	2	3	2

PROFESSIONAL ELECTIVES - III

20PCSEL309 SDG NO. 4 & 9	BIO-INSPIRED COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn bio-inspired algorithms , random walk and simulated annealing
- To learn genetic algorithm and differential evolution
- To learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

UNIT I BIO-INSPIRED COMPUTING FUNDAMENTALS 9

Introduction to Computing - Algorithm - Newton's method - Optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Meta-heuristics - Analysis of Algorithms -Nature Inspired Algorithms -Parameter tuning - parameter control- Example of Bio-inspired computing.

UNIT II RANDOM WALK AND ANNEALING 9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - Step sizes and search efficiency - Modality and intermittent search strategy - Importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

UNIT III GENETIC ALGORITHMS 9

Introduction to Genetic algorithms and - Role of genetic operators - Choice of parameters - GA variants - Schema theorem - Convergence analysis - Introduction to differential evolution - Variants - Choice of parameters - Convergence analysis - Implementation.

UNIT IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9

Biological self-organization - Swarm intelligence - PSO algorithm - Accelerated PSO - Implementation - Convergence analysis - Binary PSO - The Firefly algorithm - Algorithm analysis - Implementation - variants- Ant colony optimization toward feature selection-Swarm robotics– Artificial evolution of competing systems.

UNIT V APPLICATION IN IMAGE PROCESSING 9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm : Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search.

TOTAL: 45 PERIODS

REFERENCES:

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013.
3. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016.
4. Xin-She Yang, "Nature Inspired Optimization Algorithm,Elsevier First Edition 2014.
5. D. E. Goldberg, “Genetic algorithms in search, optimization, and machine learning”, Addison- Wesley, 1989
6. Yang, Cui,Xiao, Gandomi, Karamanoglu, “Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.
7. R. C. Ebelhart et al., “Swarm Intelligence”, Morgan Kaufmann, 2001

WEB REFERENCES:

1. https://nptel.ac.in/courses/102106068/
2. https://www.iitk.ac.in/eeold/archive/courses/2013/intel-info/d1pdf2.pdf
3. ibm.com/blogs/research/2017/11/open-source-machine-learning/
4. https://ocw.mit.edu/courses/biology/7-91j-foundations-of-computational-and-systems-biology-spring-2014/lecture-slides/

ONLINE RESOURCES:

1. https://youtu.be/_yL-gjS_6QI
2. https://youtu.be/x_OlosGwKFg
3. https://youtu.be/3OkQ72y77LM
4. https://www.youtube.com/watch?v=UiSmZhKPLNw
5. https://ocw.mit.edu/courses/biology/7-91j-foundations-of-computational-and-systems-biology-spring-2014/video-lectures/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Implement and apply bio-inspired algorithms
2. Explain random walk and simulated annealing
3. Implement and apply genetic algorithms
4. Explain swarm intelligence and ant colony for feature selection
5. Apply bio-inspired techniques in image processing.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	2	2	2	2	3	3
CO2	3	3	3	3	3	1	1	1	1	-	-	1	2	2
CO3	3	3	3	3	3	1	1	1	3	2	2	3	3	3
CO4	3	3	3	3	3	1	1	1	1	-	-	1	2	2
CO5	3	3	3	3	3	1	1	1	3	2	2	3	3	3

PROFESSIONAL ELECTIVES - III

20PCSEL310 SDG NO. 4 & 9	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To be aware of different forms of intermediate languages and analyzing programs.
- To understand optimizations techniques for simple program blocks.
- To apply optimizations on procedures, control flow and parallelism.
- To learn the inter procedural analysis and optimizations and to explore the knowledge about resource utilization.

UNIT I INTERMEDIATE REPRESENTATIONS AND ANALYSIS 9

Review of Compiler Structure- Structure of an Optimizing Compiler – Intermediate Languages - LIR, MIR, HIR – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Dependence Relations - Dependences in Loops and Testing-Basic Block Dependence DAGs – Alias Analysis.

UNIT II EARLY AND LOOP OPTIMIZATIONS 9

Importance of Code Optimization Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common - Subexpression Elimination - Loop-Invariant Code Motion - Partial-Redundancy Elimination - Redundancy Elimination and Reassociation - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.

UNIT III PROCEDURE OPTIMIZATION AND SCHEDULING 9

Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations - Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining.

UNIT IV INTER PROCEDURAL OPTIMIZATION 9

Symbol table – Runtime Support - Interprocedural Analysis and Optimization: Interprocedural Control Flow Analysis - The Call Graph - Interprocedural Data-Flow Analysis - Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural Optimizations - Interprocedural Register Allocation - Aggregation of Global References.

UNIT V REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY 9

Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.

REFERENCES:

1. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.
2. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011.
3. Randy Allen and Ken Kennedy,"Optimizing Compilers for Modern Architectures: A Dependence based Approach", Morgan Kaufman, 2001.
4. Robert Morgan ,"Building an Optimizing Compiler", Digital Press, 1998
5. Steven Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufman Publishers, 1997.

WEB REFERENCES

1. https://www.toptal.com/full-stack/code-optimization
2. https://nptel.ac.in/courses/106105190/
3. https://www.coursera.org/courses?query=compilers
4. https://lecturenotes.in/subject/67/compiler-design-cd

ONLINE RESOURCES

1. https://www.embedded.com/advanced-compiler-optimization-techniques/
2. https://www.tutorialspoint.com/compiler_design/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Identify the different forms of intermediate languages and analyzing programs.
2. Identify the different optimization techniques for simple program blocks.
3. Design performance enhancing optimization techniques.
4. Perform the optimization on procedures.
5. Ensure better utilization of resources.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	1	-	1	1	-	-	-	1	2	2
CO2	2	3	3	2	2	-	1	1	-	-	-	1	2	2
CO3	3	2	2	2	2	-	1	1	-	-	-	1	2	2
CO4	2	2	3	1	2	-	1	1	-	-	-	1	2	2
CO5	3	3	3	2	2	-	1	1	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - III

20PCSEL311 SDG NO. 4 & 9	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the IoT architecture and protocols
- To build a small low cost embedded system using Raspberry Pi & Arduino
- To apply the concept of Internet of Things in the real world scenario

UNIT I INTRODUCTION TO IoT **9**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - Information model - Functional model - Communication model - IoT Reference architecture.

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi - Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, Smart grid, Commercial building automation, Smart cities - Participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012

REFERENCES:

1. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
2. Honbo Zhou,”The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
3. Jan Holler, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

WEB REFERENCES:

1. https://www.slideshare.net/jaswindersinghthind/a-basic-ppt-on-internet-of-thingsiot
2. https://www.tutorialspoint.com/internet_of_things/internet_of_things_technology_and_protocols.htm
3. https://www.arduino.cc/

ONLINE RESOURCES:

1. https://lecturenotes.in/subject/370/internet-of-things-IOT
2. https://www.tutorialspoint.com/internet_of_things/internet_of_things_tutorial.pdf
3. https://innovationatwork.ieee.org/internet-of-things/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Analyze various protocols for IoT
2. Develop Web services to access/control IoT devices.
3. Design a portable IoT using Raspberry Pi
4. Deploy an IoT application and connect to the cloud.
5. Analyze applications of IoT in real time scenario

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	2	1	1	-	1	-	-	1	2	3
CO2	2	2	2	3	2	2	1	-	1	-	-	1	2	3
CO3	2	3	2	3	2	1	1	-	1	-	-	1	2	2
CO4	2	3	2	3	2	2	1	-	3	-	-	1	2	2
CO5	2	3	2	3	2	3	1	-	3	-	-	2	2	3

PROFESSIONAL ELECTIVES - III

20PCNEL306 SDG NO. 4	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the components of the social network
- To model and visualize the social network
- To analyze the users in the social network
- To comprehend the evolution of the social network

UNIT I INTRODUCTION **9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT II MODELING AND VISUALIZATION **9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT III MINING COMMUNITIES **9**

Aggregating and reasoning with social network data- Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection and Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT IV EVOLUTION **9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location - Without Graph Constraints - With Score Propagation – Expert Team Formation - Link Prediction in Social Networks -

Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT V APPLICATIONS **9**

Learning Based Approach for Real Time Emotion Classification of Tweets - New Linguistic Approach to assess the Opinion of Users in Social Network Environments - Explaining Scientific and Technical Emergence Forecasting - Social Network Analysis for Biometric Template Protection.

TOTAL: 45 PERIODS

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien, Vaclav Snasel ,"Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1 st edition, 2011
3. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2014
4. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
5. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2012
6. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
7. Przemyslaw Kazienko, Nitesh Chawla,"Applications of Social Media and Social Network Analysis", Springer,2015

WEB REFERENCES:

1. https://learnengineering.in/cs6010-social-network-analysis/
2. https://ocw.mit.edu/courses/sloan-school-of-management/15-599-workshop-in-it-collaborative-innovation-networks-fall-2011/lecture-notes/MIT15_599F11_lec04.pdf
3. https://www.scribd.com/document/390705690/CS6010-SOCIAL-NETWORK-ANALYSIS-Unit-1-Notes.

OUTCOMES:

Upon Completion of the course, the students should be able to

1. Understand the working on the internals components of the social network.
2. Analyze the model and visualize the social network.

3. Apply various network and mine the behaviour of the users in the social network
4. Predict the possible next outcome of the social network.
5. Implement social network in real time applications.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	1	-	-	3	1	2	1	1
CO2	3	3	2	2	1	-	1	-	-	3	2	2	1	1
CO3	3	3	3	2	2	-	2	2	-	3	2	3	1	1
CO4	3	3	2	2	1	-	1	1	-	3	1	2	1	1
CO5	3	3	2	2	3	3	2	1	0	3	3	3	3	3

PROFESSIONAL ELECTIVES - IV

20PCSEL312 SDG NO.4,8,9 &12	DATA 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 visualization for time-series analysis and ranking analysis.
- To understand visualization for deviation analysis and distribution analysis, correlation analysis and multivariate analysis.

UNIT I CORE SKILLS FOR VISUAL ANALYSIS 9

Information Visualization – Effective Data Analysis – Traits of Meaningful Data – Visual Perception –Making Abstract Data Visible – Building Blocks Of Information Visualization – Analytical Interaction – Analytical Navigation – Optimal Quantitative Scales – Reference Lines And Regions – Trellises And Crosstabs – Multiple Concurrent Views – Focus And Context – Details On Demand – Over-Plotting Reduction – Analytical Patterns – Pattern Examples.

UNIT II TIME-SERIES, RANKING AND DEVIATION ANALYSIS 9

Time-Series Analysis – Time-Series Patterns – Time-Series Displays – Time-Series Best Practices – Part-To-Whole and Ranking Patterns – Part-To-Whole and Ranking Displays – Best Practices – Deviation Analysis – Deviation

Analysis Displays – Deviation Analysis Best Practices.

UNIT III DISTRIBUTION, CORRELATION AND MULTIVARIATE ANALYSIS **9**

Distribution Analysis – Describing Distributions – Distribution Patterns – Distribution Displays – Distribution Analysis Best Practices – Correlation Analysis – Describing Correlations – Correlation Patterns – Correlation Displays – Correlation Analysis Techniques And Best Practices – Multivariate Analysis – Multivariate Patterns – Multivariate Displays – Multivariate Analysis Techniques And Best Practices..

UNIT IV INFORMATION DASHBOARD DESIGN **9**

Information Dashboard – Introduction– Dashboard Design Issues And Assessment Of Needs – Considerations For Designing Dashboard-Visual Perception – Achieving Eloquence.

UNIT V INFORMATION DASHBOARD DESIGN **9**

Advantages Of Graphics - Library Of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting It All Together-Unveiling The Dashboard.

TOTAL: 45 PERIODS

REFERENCES:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.

WEB REFERENCES:

1. https://www.tutorialspoint.com/business_writing_skills/data_visualization.htm
2. https://www.javatpoint.com/what-is-data-visualization
3. https://www.houseofbots.com/news-detail/12244-1-famous-tutorials-of-the-data-visualization-techniques

ONLINE RESOURCES:

1. https://sites.tufts.edu/gis/files/2016/02/Introduction_to_Data_Visualization.pdf
2. https://haralick.org/DV/Handbook_of_Data_Visualization.pdf
3. http://index-of.co.uk/Misc/O'Reilly%20Visualizing%20Data.pdf
4. https://web.stanford.edu/group/toolingup/cgi-bin/toolkit/wp-content/uploads/2011/03/GMcGhee_toolingup_DataVis_110506.pdf
5. http://courses.ischool.utexas.edu/unmil/files/Designing_Data_Visualizations.pdf

OUTCOMES:

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

1. Explain principles of visual perception
2. Apply core skills for visual analysis
3. Apply visualization techniques for various data analysis tasks
4. Design information dashboard
5. Analyze visualization for multivariate

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	1	1	1	2	2	2
CO2	2	3	3	2	2	1	1	2	1	1	1	1	2	1
CO3	3	3	3	3	3	1	1	1	1	1	1	2	2	2
CO4	3	2	2	3	3	2	1	1	1	1	1	2	1	1
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2

PROFESSIONAL ELECTIVES - IV

20PCSEL313 SDG NO. 4 & 16	RECONFIGURABLE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for reconfigurable computing
- To expose the students to various device architectures and examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable architectures
- To expose the students to HDL programming, various placement, routing protocols and to familiarize with the development environment, develop applications with FPGAs

UNIT I DEVICE ARCHITECTURE 9

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

UNIT II RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS 9

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

UNIT III PROGRAMMING RECONFIGURABLE SYSTEMS 9

Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.

UNIT IV MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS 9

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bit stream Generation – Case Studies with Appropriate Tools.

UNIT V APPLICATION DEVELOPMENT WITH FPGAS 9

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Christophe Bobda, "Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications", Springer, 2010.

REFERENCES:

1. Scott Hauck and Andre Dehon (Eds.), "Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation", Elsevier / Morgan Kaufmann, 2008.
2. Maya B. Gokhale and Paul S. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays", Springer, 2005.

WEB REFERENCES:

1. http://scale.engin.brown.edu/classes/EN2911XF07/index.html
2. https://cs.uni-paderborn.de/?id=24991
3. https://ieeexplore.ieee.org/document/979719 (Chortle-crf: fast technology mapping for lookup table-based FPGAs)
4. https://ieeexplore.ieee.org/document/979719 (Chortle-crf: fast technology mapping for lookup table-based FPGAs)
5. https://ieeexplore.ieee.org/document/273754(FlowMap: an optimal technology mapping algorithm for delay optimization in lookup-table based FPGA designs)
6. https://barrgroup.com/embedded-systems/how-to/reconfigurable-computing

ONLINE RESOURCES:

1. http://www.uni-hamburg.de/ (see Documentation link for free books)
2. https://www.fpga4fun.com (Easy FPGA tutorials, projects, and boards)
3. http://iverilog.icarus.com(Icarus open-source Verilog)

OUTCOMES:

Upon completion of the course, the student should be able to

1. Identify the need for reconfigurable architectures and Point out the salient features of different reconfigurable architectures
2. Discuss the architecture of FPGAs
3. Build basic modules using any HDL.
4. Develop applications using any HDL and appropriate tools
5. Design and build an SoPC for a particular application

CO- PO,PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	1	1	-	-	-	1	2	2
CO2	3	3	3	2	2	-	1	1	-	-	-	1	2	2
CO3	3	3	2	2	2	-	1	1	-	-	-	1	2	2
CO4	2	2	3	2	2	-	1	1	-	-	-	1	2	2
CO5	2	3	3	2	2	-	1	1	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - IV

20PCSEL314 SDG NO. 4 & 9	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design and implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

UNIT I INTRODUCTION **9**

Introduction to Mobile applications – Embedded systems - Market and Business drivers for Mobile applications – Publishing and Delivery of Mobile applications – Requirements gathering and Validation for Mobile applications

UNIT II BASIC DESIGN **9**

Introduction – Basics of Embedded systems design – Embedded OS - Design constraints for Mobile applications - Both Hardware and Software related – Architecting mobile applications – User interfaces for mobile applications – Touch events and Gestures – Achieving quality constraints – Performance, Usability, Security, Availability and Modifiability.

UNIT III ADVANCED DESIGN **9**

Designing applications with Multimedia and Web access capabilities – Integration with GPS and Social media networking applications – Accessing applications hosted in a Cloud Computing environment – Design patterns for mobile applications.

UNIT IV TECHNOLOGY I - ANDROID **9**

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with Server Side applications using Google Maps, GPS and Wifi – Integration with Social Media applications.

UNIT V TECHNOLOGY II - IOS **9**

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application using Wifi - iPhone marketplace.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
2. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012.

REFERENCES:

1. James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.

ONLINE RESOURCE:

1. https://nptel.ac.in/courses/106/106/106106147/

WEB REFERENCE

1. http://developer.android.com/develop/index.html

OUTCOMES:

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

1. Describe the requirements for mobile applications.
2. Explain the challenges in mobile application design and development.
3. Develop and design mobile applications for specific requirements.
4. Implement the design using Android SDK.
5. Implement the design using Objective C and iOS and deploy mobile applications in Android and iPhone marketplace for distribution.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	2	-	-	1	1	2	2	3	2
CO2	3	3	3	2	1	2	-	-	1	1	2	2	3	2
CO3	3	3	3	2	1	2	-	-	1	1	2	2	3	2
CO4	3	3	3	2	3	2	-	-	1	1	2	2	3	2
CO5	3	3	3	2	3	2	-	-	2	3	2	2	3	2

PROFESSIONAL ELECTIVES - IV

20PCSEL315 SDG NO. 3 & 4	BIO INFORMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposed to the fundamentals of bioinformatics.
- To analyze DNA sequencing data and detection of genomic variants.
- To learn and understand open problems, issues in replication, assemble genome, various clustering and multiple pattern matching.
- To study and be exposed to the domain of animal genomics.

UNIT I INTRODUCTION AND FUNDAMENTALS 9

Fundamentals of Genes, Genomics, Molecular Evolution – Genomic Technologies –Beginning of Bioinformatics - Genetic Data –Sequence Data Formats – Secondary Database – Examples – Data Retrieval Systems – Genome Browsers - Biomedical Data –Their Acquisition, Storage and Use, Electronic Health Records (EHR), Information Retrieval From Digital Libraries.

UNIT II GENOMICS AND EPIGENOMICS 9

Genomic Variants Detection and Genotyping - Computational approaches for Finding Long Insertions and Deletions with NGS Data- Computational Approaches in Next-Generation Sequencing Data Analysis for Genome-Wide DNA Methylation Studies- Bisulfite-Conversion-Based Methods for DNA Methylation Sequencing Data Analysis

UNIT III DNA REPLICATION AND ASSEMBLE GENOME 9

Beginning of DNA Replication – Open Problems – Multiple Replication and

Finding Replication – Computing Probabilities of Patterns in a String-The Frequency Array-Converting Patterns-Solving Problems- Finding Frequents Words-Big-O Notation –Case Study-The Tower Of Hanoi Problem-Assemble Genome-String Reconstruction Problem-Assembling Genomes from Read Pairs.

UNIT IV BIOINFORMATICS CLUSTERING AND PATTERN MATCHING 9

Introduction to Clustering- Good Clustering Principle-K-Means Clustering-Lloyd Algorithm-Making Soft Decisions in Coin Flipping-Clustering Tumor Samples-Introduction to Multiple Pattern Matching-Burrows-Wheeler Transform-Pattern Matching with the Burrows-Wheeler Transform-Epilogue: Mismatch-Tolerant Read Mapping.

UNIT V ANIMAL GENOME 9

Human and Mouse Genomes-Random Breakage Model of Chromosome Evolution – Sorting by Reversals – Greedy Heuristic Approach – Break Points Graphs-Neighbor-Joining Algorithm-Character Based Tree Reconstruction.

TOTAL: 45 PERIODS

REFERENCES:

1. Philip Compeau and Pavel Pevzner, "Bioinformatics Algorithms: An Active Learning Approach" Second Edition Volume I , Coursera, 2015.
2. Supratim Choudhuri, "Bioinformatics For Beginners", Elsevier, 2014.
3. Biomedical Informatics: Computer applications in Health care and Biomedicine (3rd ed), by Shortliffe EH, Ciminio JJ., 2000, New York Springer-Verlag, ISBN 0-387-28986-0.
4. Ion Mandoiu and Alexander Zelikovsky , "Computational Methods for Next Generation Sequencing Data Analysis " Wiley series 2016.
5. Robert F.Coughlin, Istvan Miklos,Renyi Institute, "Introduction to algorithms in Bioinformatics",Springer 2016.

WEB REFERENCES:

1. https://www.bits.vib.be/index.php/training/122-basic-bioinformatics
2. http://bioinfo.mbb.yale.edu/mbb452a/intro/
3. http://pages.cs.wisc.edu/~bsettles/ibs08/lectures/01-intro.pdf

ONLINE RESOURCE:

1. https://www.youtube.com/user/NCBINLM

OUTCOMES:

Upon Completion of this course, the students should be able to

1. Deploy the Genomics Technologies in Bioinformatics.
2. Able to distinguish Epigenomics and Genomics.
3. Deploy the replication and molecular clocks in Bioinformatics.
4. Implement various Clustering and Pattern Matching techniques
5. Use the Breakpoint Graphs for Genome Expression.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	1	-	1	2	-	1	2	2
CO2	1	-	2	2	-	2	2	-	-	-	-	1	2	2
CO3	2	2	2	1	-	2	1	-	-	-	-	1	2	1
CO4	2	2	2	1	1	2	1	-	-	-	-	1	2	2
CO5	2	2	2	2	-	2	1	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - IV

20PCNEL308 SDG NO. 4	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the storage architecture and technologies in Information management
- Learn to establish and manage a data center
- Learn various storage technologies for the required application
- Apply security measures to the data center

UNIT I STORAGE TECHNOLOGY **9**

Review data creation - Amount of data being created - Understand the value of data to a business - Challenges in data storage and data management - Solutions available for data storage - Core elements of a data center infrastructure - Role of each element in supporting business activities.

UNIT II STORAGE SYSTEM ARCHITECTURE 9

Hardware and software components of the host environment - Key protocols and concepts used by each component - Physical and logical components of a connectivity environment - Major physical components of a disk drive and their function - Logical constructs of a physical disk - Access characteristics - Performance Implications - Concept of RAID and its components - Different RAID levels and their suitability for different application environments - Compare and contrast integrated and modular storage systems - High-level architecture and working of an intelligent storage system.

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

Evolution of networked storage - Architecture - Components - Topologies of FC-SAN - NAS - IP-SAN - Benefits of the different networked storage options - Understand the need for long-Term archiving solutions - Describe how CAS fullfill the need - Understand the appropriateness - Different networked storage options - Different application environments.

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATA CENTERS 9

List reasons for planned or unplanned outages - Impact of downtime - Business continuity (BC) - Disaster recovery (DR) - RTO - RPO - Identify single points of failure - List solutions to mitigate failures - Architecture of backup/recovery - Different backup or recovery topologies - Replication technologies - Role in ensuring information availability and business continuity - Remote replication technologies - Role in providing disaster recovery and business continuity capabilities - Identify key areas to monitor in a data center - Industry standards for data center monitoring and management - Key metrics - Key management tasks.

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

Information security - Critical security attributes - Storage security domains - List and analyze the common threats in each domain - Virtualization technologies - Block-level and file-level virtualization technologies and processes.

TOTAL: 45 PERIODS

REFERENCES:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010.
2. Marc Farley, “Building Storage Networks”, Tata McGraw Hill” ,Osborne, 2001.

3. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill , Osborne, 2003.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106108058/.

ONLINE RESOURCES:

1. https://dokumen.tips/engineering/cp7029-information-storage-management-notes-58f9ada4e0e17.html.

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the basics of storage management for Information maintenance.
2. Study the requirements and strategies for the data center.
3. Learn various storage technologies for the required application.
4. Apply security measures to data center.
5. Analyze Quality of Service in Storage.

CO- PO,PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	1	-	-	-	2	2	2
CO2	3	2	2	-	-	-	-	2	-	-	-	2	2	2
CO3	3	3	3	-	-	-	-	1	-	-	-	-	2	2
CO4	3	3	3	-	-	-	-	1	-	-	-	-	2	2
CO5	3	3	3	-	-	-	-	1	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - IV

20PCNEL311 SDG NO. 4	ETHICAL HACKING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand and analyse Information security threats and counter measures
- To perform security auditing & testing
- To understand issues relating to ethical hacking
- To study & employ network defense measures

UNIT I ETHICAL HACKING OVERVIEW & VULNERABILITIES 9

Understanding the importance of security-Concept of ethical hacking and essential TerminologiesThreat- Attack- Vulnerabilities- Target of Evaluation-Exploit. Phases involved in hacking.

UNIT II FOOTPRINTING & PORT SCANNING 9

Footprinting - Introduction to foot printing- Understanding the information gathering methodology of the hackers-Tools used for the reconnaissance phase.Port Scanning - Introduction- using port scanning tools- Ping sweeps-Scripting Enumeration-Introduction- Enumerating windows OS & Linux OS.

UNIT III SYSTEM HACKING 9

Aspect of remote password guessing- Role of eavesdropping -Various methods of password cracking- Keystroke Loggers- Understanding Sniffers - Comprehending Active and Passive Sniffing- ARP Spoofing and Redirection-DNS and IP Sniffing- HTTPS Sniffing.

UNIT IV HACKING WEB SERVICES & SESSION HIJACKING 9

Web application vulnerabilities- Application coding errors- SQL injection into Back-end Databases- Cross-site scripting- cross-Site request forging-Authentication bypass- Web services and related flaws- Protective http headers Understanding Session Hijacking- Phases involved in Session Hijacking-Types of Session Hijacking- Session Hijacking Tools

UNIT V HACKING WIRELESS NETWORKS 9

Introduction to 802.11-Role of WEP- Cracking WEP Keys- SniffingTraffic-WirelessDOSattacks-WLANScanners-WLANSniffers-HackingTools-Securing Wireless Networks.

TOTAL: 45 PERIODS

REFERENCES:

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010.
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010
3. Patrick Engebretson, "The Basics of Hacking and Penetration Testing" Ethical Hacking and Penetration Testing Made Easy, Syngress Media, Second Revised Edition, 2013.
4. RajatKhare, "Network Security and Ethical Hacking", Luniver Press, 2006.
5. Ramachandran V, "Wireless Penetration Testing Beginner's Guide " 3rd ed.. Packt Publishing, 2011.
6. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003.

WEB REFERENCES:

1. https://www.elsevier.com/books/
2. https://www.elsevier.com/books/cyber-security-awareness-for-lawyers
3. https://books.google.co.in/books

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/ethical-hacking
2. https://nptel.ac.in/courses

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand and identify the vulnerabilities/threats/attacks.
2. Understand penetration & security testing.
3. Use safe penetration techniques on the World Wide Web.
4. Design a computer against a variety of security attacks using various tools.
5. Become a professional ethical hacker.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	1	3	3	2	2	3	3	2
CO2	2	3	3	3	3	2	1	3	3	2	2	3	3	3
CO3	2	3	3	2	3	2	2	3	3	3	2	3	3	3
CO4	2	3	3	3	3	2	1	3	3	3	2	3	3	3
CO5	3	3	3	3	3	2	2	3	3	3	2	3	3	3

Imagine the Future and

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by investments in INDUSTRY, INNOVATION AND INFRASTRUCTURE that will help us to

REDUCE INEQUALITIES by all means. We will live in SUSTAINABLE CITIES AND COMMUNITIES.

RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet.

CLIMATE ACTION will reduce global warming and we will have abundant,

flourishing LIFE BELOW WATER, rich and diverse LIFE ON LAND.

We will enjoy PEACE AND JUSTICE through STRONG INSTITUTIONS

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