MUTHAYAMMAL ENGINEERING COLLEGE

An Autonomous Institution

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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Curriculum/Syllabus

Programme Code : MC

Programme Name : M.E.-Computer Science and Engineering

Regulation : 2023

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Email: info@mec.ac.in

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DESIGNING YOUR FUTURE
Estd. 2000

Institution Vision & Mission

Institution Vision

- To be a Centre of Excellence in Engineering, Technology and Management on par with International Standards.

Institution Mission

- To prepare the students with high professional skills and ethical values.
- To impart knowledge through best practices.
- To instill a spirit of innovation through Training, Research and Development.
- To undertake continuous assessment and remedial measures.
- To achieve academic excellence through intellectual, emotional and social stimulation.

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Department Vision & Mission

Department Vision

- To produce the Computer Science and Engineering graduates with the Innovative and Entrepreneur skills to face the challenges ahead.

Department Mission

- To impart knowledge in the state of art technologies in Computer Science and Engineering.
- To inculcate the analytical and logical skills in the field of Computer Science and Engineering.
- To prepare the graduates with Ethical values to become successful Entrepreneurs.

Program Educational Objectives

PEO1 : Graduates will be able to Practice as an IT Professional in Multinational Companies.

PEO2 : Graduates will be able to Gain necessary skills and to pursue higher education for career growth.

PEO3 : Graduates will be able to Exhibit the leadership skills and ethical values in the day to day life.

Program Specific Outcomes

PSO1 : Graduates should be able to design and analyze the algorithms to develop an Intelligent Systems.

PSO2 : Graduates should be able to apply the acquired skills to provide efficient solutions for real time problems.

PSO3 : Graduates should be able to exhibit an understanding of System Architecture, Networking and Information Security.

Program Outcomes

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 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 modeling 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 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 : **Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

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M.E. – Computer Science and Engineering
Grouping of Courses

I. Foundation Courses (FC)

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
1.	23CSA01	Advanced Numerical Methods	FC	5	3	2	0	4
2.	23CSA02	Applied Mathematics	FC	5	3	2	0	4
3.	23CSA03	Applied Probability And Statistics	FC	5	3	2	0	4

II. Professional Core (PC)

1.	23CSB01	Advanced Data Structures and Algorithms	PC	3	3	0	0	3
2.	23CSB02	Advanced Data Structures and Algorithms Laboratory	PC	2	0	0	2	1
3.	23CSB03	Machine learning techniques	PC	3	3	0	0	3
4.	23CSB04	Machine learning techniques Laboratory	PC	2	0	0	2	1
5.	23CSB05	Cloud Computing	PC	3	3	0	0	3
6.	23CSB06	Cloud Computing Laboratory	PC	2	0	0	2	1
7.	23CSB07	Advanced operating systems	PC	3	3	0	0	3
8.	23CSB08	Image Processing and Analysis	PC	3	3	0	0	3
9.	23CSB09	Image Processing and Analysis Laboratory	PC	2	0	0	2	1
10.	23CSB10	Soft Computing	PC	3	3	0	0	3
11.	23CSB11	Research Methodology and IPR	PC	3	3	0	0	3
12.	23CSB12	Data Mining Techniques	PC	3	3	0	0	3
13.	23CSB13	Network Design and Technologies	PC	3	3	0	0	3
14.	23CSB14	Advanced Software Engineering	PC	3	3	0	0	3
15.	23CSB15	Advanced Database Technology	PC	3	3	0	0	3
16.	23CSB16	Advanced Database Technology Laboratory	PC	2	0	0	2	1
17.	23CSB17	Big Data Analytics	PC	3	3	0	0	3
18.	23CSB18	Foundations of Data Science	PC	3	3	0	0	3
19.	23CSB19	Cognitive Computing	PC	3	3	0	0	3
20.	23CSB20	Natural Language Processing	PC	3	3	0	0	3
21.	23CSB21	Compiler Design Techniques	PC	3	3	0	0	3
22.	23CSB22	Virtualization Techniques	PC	3	3	0	0	3

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III. Professional Elective (PE)

1.	23CSC01	Advanced Algorithms	PE	3	3	0	0	3
2.	23CSC02	Advanced Algorithm Laboratory	PE	2	0	0	2	1
3.	23CSC03	Web Data Mining	PE	3	3	0	0	3
4.	23CSC04	Web Analytics and Development	PE	3	3	0	0	3
5.	23CSC05	Data Storage Technologies and Networks	PE	3	3	0	0	3
6.	23CSC06	Pattern classification and Analysis	PE	3	3	0	0	3
7.	23CSC07	Mobile and Pervasive Computing	PE	3	3	0	0	3
8.	23CSC08	Ad Hoc and Wireless Sensor Networks	PE	3	3	0	0	3
9.	23CSC09	Internet of things	PE	3	3	0	0	3
10.	23CSC10	Internet of things Laborarory	PE	2	0	0	2	1
11.	23CSC11	Data Preparation and Analysis	PE	3	3	0	0	3
12.	23CSC12	Advanced Computer Architecture	PE	3	3	0	0	3
13.	23CSC13	Multicore Architecture	PE	3	3	0	0	3
14.	23CSC14	Wireless Sensor Networks	PE	3	3	0	0	3
15.	23CSC15	Computer Vision	PE	3	3	0	0	3
16.	23CSC16	Block Chain Technologies	PE	3	3	0	0	3
17.	23CSC17	Cyber Physical Systems	PE	3	3	0	0	3
18.	23CSC18	Full stack Development	PE	3	3	0	0	3
19.	23CSC19	Fog & Edge Computing	PE	3	3	0	0	3
20.	23CSC20	GPU computing	PE	3	3	0	0	3

IV. Employability Enhancement Courses (EEC)

1.	23CSD01	Technical Seminar	EEC	2	2	0	0	2
2.	23CSD02	Project Phase I	EEC	12	0	0	12	6
3.	23CSD03	Project Phase II	EEC	24	0	0	24	12
4.	23CSD04	Value Education	EEC	2	2	0	0	0
5.	23CSD05	Disaster Management	EEC	2	2	0	0	0
6.	23CSD06	English for Research Paper Writing	EEC	2	2	0	0	0
7.	23CSD07	Constitution of India	EEC	2	2	0	0	0

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M.E. – Computer Science and Engineering
Curriculum | PG - R2023
Semester -I

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23CSA02	Applied Mathematics	FC	5	3	2	0	4
2.	23CSB03	Machine Learning Techniques	PC	3	3	0	0	3
3.	23CSB05	Cloud Computing	PC	3	3	0	0	3
4.	23CSB11	Research Methodology and IPR	PC	3	3	0	0	3
5.	23CSB12	Data Mining Techniques	PC	3	3	0	0	3
6.	PE	Professional Elective - I	PE	3	3	0	0	3
Practical								
7.	23CSB04	Machine Learning Techniques Lab	PC	2	0	0	2	1
8.	23CSB06	Cloud Computing Lab	PC	2	0	0	2	1
							Total Credit	**21**

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Semester -II

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23CSB08	Image Processing and Analysis	PC	3	3	0	0	3
2.	23CSB13	Network Design and Technologies	PC	3	3	0	0	3
3.	23CSB17	Big Data Analytics	PC	3	3	0	0	3
4.	PE	Professional Elective - II	PE	3	3	0	0	3
5.	PE	Professional Elective - III	PE	3	3	0	0	3
Practical								
6.	23CSB09	Image Processing and Analysis	PC	2	0	0	2	1
7.	PE	Professional Elective - II Lab	PE	2	0	0	2	1
8.	23CSD01	Technical Seminar	EEC	2	0	0	2	1
							Total Credit	**18**

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M.E. – Computer Science and Engineering
Curriculum | PG - R2023
Semester -III

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	PE	Professional Elective - IV	PE	3	3	0	0	3
2.	PE	Professional Elective - V	PE	3	3	0	0	3
Practical								
3.	23CSD02	Project Phase - I	EEC	12	0	0	12	6
							Total Credit	**12**

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M.E. – Computer Science and Engineering
Curriculum | PG - R2023

Semester -IV

Sl.No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Practical								
1.	23CSD03	Project Phase - II	EEC	24	0	0	24	12
							Total Credit	**12**

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M.E. – Computer Science and Engineering
Curriculum | PG - R2023

Summary of Course Component

Sl.No.	Course Area	Semesters				Total Credits	% of Credits
		I	II	III	IV		
1.	FC	6	-	-	-	6	10
2.	PC	12	10	-	-	22	35
3.	PE	3	7	6	-	16	25
4.	EEC	-	1	6	12	19	30
Total		**21**	**18**	**12**	**12**	**63**	**100**

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23CSA01	ADVANCED NUMERICAL METHODS	L	T	P	C
		3	2	0	4

Course Objective:

- To learn the algebraic equations this finds applications in many engineering branches
- To make the student acquire sound knowledge of computational techniques in solving ordinary differential equations that model engineering
- To solve Elliptic equations by using computational techniques
- To introduce numerical tools for the solutions of partial differential equations that model several physical processes
- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology

Course Outcomes:

23CSA01.CO1	Demonstrate understanding and implementation of numerical solution algorithms applied to solve algebraic equations.
23CSA01.CO2	Be familiar with numerical solutions of ordinary differential equation and partial differential Equations.
23CSA01.CO3	Be competent with finite difference method and finite element method.
23CSA01.CO4	Understanding the theoretical and practical aspects of the use of numerical methods. Implementing numerical methods for a variety of multidisciplinary applications. Establishing the limitations, advantages, and disadvantages of numerical methods.
23CSA01.CO5	The students will have a clear perception of the power of numerical Techniques. This will also Serve as a precursor for future research.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSA01.CO1	X	X	X	-	-	-	-	-	-	-	X	X	-	-	-
23CSA01.CO2	X	X	X	-	-	-	-	-	-	-	X	X	-	-	-
23CSA01.CO3	X	X	X	-	-	-	-	-	-	-	X	X	-	-	-
23CSA01.CO4	X	X	X	-	-	-	-	-	-	-	X	X	-	-	-
23CSA01.CO5	X	X	X	-	-	-	-	-	-	-	X	X	-	-	-

Unit-I ALGEBRAIC EQUATIONS 9+6

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, inverse power method, Faddeev – Leverrier Method

Unit-II ORDINARY DIFFERENTIAL EQUATIONS 9+6

Runge Kutta Methods for system of IVPs, numerical stability, Adams - Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, galerkin finite element method.

Unit-III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS 9+6

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme - Stability of above schemes.

Unit-IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 9+6

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

Unit-V FINITE ELEMENT METHOD 9+6

Partial differential equations – Finite element method – orthogonal collocation method, orthogonal Collocation with finite element method, Galerkin finite element method.

Total Periods: 75

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.K. Jain , S.R.K. Iyengar, R.K. Jain	Computational Methods for Partial Differential Equations, 2nd Edition	New Age Publishers	2016
2.	S. K. Gupta	Numerical Methods for Engineers, 3rd Edition	New Age International Pvt Ltd Publishers	2015
3.	Saumyen Guha and Rajesh Srivastava	Numerical methods for Engineering and Science	Oxford Higher Education, New Delhi	2010
4.	M.K. Jain	Numerical Methods for Scientific & Engineering	New Age International Publishers	2010
5.	Burden, R.L., and Faires, J.D.	Numerical Analysis –Theory and Applications	India Edition, New Delhi	2009

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23CSA02	APPLIED MATHEMATICS	L	T	P	C
		3	2	0	4

Course Objective:

- To realize the use of matrix theory techniques in engineering applications and to develop for future applications
- To analyze and solve the fundamental problem with prescribed or free boundary conditions in simple cases
- Demonstrate knowledge of mathematics and mechanics to construct, analyze and interpret real world
- Problems
- Provide a foundation and motivation for exposure to statistical ideas subsequent to the course
- To formulate and construct a mathematical model for a linear programming problem in real life situation

Course Outcomes:

23CSA02.CO1	Explain geometrical concepts related to orthogonality and least squares solutions and perform calculations related to orthogonally.
23CSA02.CO2	The variational calculus makes access to mastering in a wide range of classical results of variational calculus. Students get up apply results in technical problem solutions.
23CSA02.CO3	The students will have a basic knowledge of the main fields of mathematics and mechanics, Including differential equations, elasticity theory, fluid mechanics.
23CSA02.CO4	The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
23CSA02.CO5	The knowledge gained on this course helps the students to do engineering optimization.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSA02.CO1	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA02.CO2	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA02.CO3	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA02.CO4	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA02.CO5	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-

Unit-I MATRIX THEORY 9+6

The Cholesky decomposition - Generalized Eigen vectors, Canonical basis - QR factorization - Least squares method - Singular value decomposition.

Unit-II CALCULUS OF VARIATIONS 9+6

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – problems with constraints - Direct methods: Ritz and Kantorovich methods.

Unit-III ONE DIMENSIONAL RANDOM VARIABLES 9+6

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

Unit-IV LINEAR PROGRAMMING 9+6

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models, schemes – approximation of derivatives near a curved boundary while using a square mesh.

Unit-V FOURIER SERIES AND EIGEN VALUE PROBLEMS 9+6

Fourier Trigonometric series: Periodic function as power signals – Convergence of series – Even and odd function: cosine and sine series – Non-periodic function: Extension to other intervals - Power signals: Exponential Fourier

series – Parseval's theorem and power spectrum – Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems – Generalized Fourier series.

Total Periods: 75

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mital.K.V. Mohan and Chander	Optimization Methods in Operations Research and Systems Analysis, 4th Edition	New Age International Publishers	2016
2.	Stark. H., and Woods. J.W	Probability and Random Processes with Applications to Signal Processing, 4th Edition	Pearson Education, Asia	2014
3.	Hamdy ATaha	Operations Research, 9th Edition (Asia)	Pearson Education, Asia	2014
4.	Gupta A.S.	Calculus of Variations with Applications	Prentice Hall of India Pvt. Ltd., New Delhi	2011
5.	Richard Bronson	Matrix Operation, Schaum's outline series, 2nd Edition	McGraw Hill	2011

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23CSA03	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		3	2	0	4

Course Objective:

- To introduce the basic concepts of one dimensional and two dimensional Random Variables
- To gain knowledge in the application of family of random variables in real life situations
- To provide information about Correlation and Regression
- Learn about maximum likelihood estimation, unbiased estimation and least square methods
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis

Course Outcomes:

23CSA03.CO1	Analyze random or unpredictable experiments and investigate important features of random Experiments. Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.
23CSA03.CO2	Associate random variables by designing joint distributions and correlate the random variables.
23CSA03.CO3	Perform and interpret correlation and regression analysis and develop correlation models to predict changes in processes and products for linear and non-linear relationships.
23CSA03.CO4	Be familiar with multivariate analysis.
23CSA03.CO5	The student will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSA03.CO1	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA03.CO2	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA03.CO3	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA03.CO4	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-
23CSA03.CO5	X	X	X	-	-	-	-	-	-	-	X	X	-	X	-

Unit-I ONE DIMENSIONAL RANDOM VARIABLES 9+6

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

Unit-II TWO DIMENSIONAL RANDOM VARIABLES 9+6

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

Unit-III ESTIMATION THEORY 9+6

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

Unit-IV TESTING OF HYPOTHESES 9+6

Sampling distributions - Type I and Type II errors - 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 9+6

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 Periods: 75

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Douglas C. Montgomery, George C. Runger	Applied Statistics and Probability for Engineers (International Student Version), 6th Edition	John Wiley & Sons, Inc.	2016
2.	Richard A. Johnson and Dean W. Wichern	Applied Multivariate Statistical Analysis, 6th Edition	Pearson Education, Asia	2015
3.	Gupta S.C. and Kapoor V.K	Fundamentals of Mathematical Statistics	Sultan Chand & Sons	2014
4.	HweiP.Hsu	Schaum‟s Outline of Theory and Problems of Probability, Random Variables and Random Processes	Tata McGraw Hill Edition, New Delhi	2011
5.	Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K.	Probability and Statistics for Engineers and Scientists, 8th Edition	Pearson Education, Asia	2013

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23CSB01	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

Course Objective:

- To review the basic data structures such as list, stack & queue and introduce concurrency on them.
- To learn advanced search structures such as Splay tree, Red Black trees, Multi way search tree and Skip lists
- To study advanced heap structures such as Leftist Heaps, Binomial Heaps and Fibonacci Heaps
- To introduce various advanced concurrent structures
- To learn the various advanced algorithms

Course Outcomes:

23CSB01.C01 Implement and apply concurrency in linked lists, stacks and queues.

23CSB01.C02 Perform operations on advanced search trees.

23CSB01.C03 Design and implement various types of advanced heaps structures.

23CSB01.C04 Implement advanced concurrent structures such as hash table & priority queue.

23CSB01.C05 Solve applications using advanced algorithm such as Randomized, Approximation and Parallel algorithms

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB01.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	X	-
23CSB01.CO2	X	X	X	-	-	-	-	-	-	-	-	-	X	X	-
23CSB01.CO3	-	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23CSB01.CO4	-	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23CSB01.CO5	-	-	X	X	X	-	-	-	-	-	-	-	X	X	-

Unit-I DATA STRUCTURES AND CONCURRENCY 9

Review of elementary data structures – data structures and concurrency – locking linked lists – coarse-grained synchronization – fine-grained synchronization – lazy synchronization – non-blocking synchronization – concurrent queues – bounded partial queues – unbounded lock-free queues – dual data structures – concurrent stacks – elimination back off stack.

Unit-II ADVANCED SEARCH STRUCTURES 9

Binary Search tree - Splay tree - Red Black trees – Interval tree - 2-D tree – Digital Search tree – Multi way Tree - Skip lists.

Unit-III ADVANCED HEAP STRUCTURES 9

Min heap - Min-Max heap - Double ended heap – Leftist Heaps - Binomial Heaps – Fibonacci Heaps – Skew Heaps - Interval Heap.

Unit-IV ADVANCED CONCURRENT STRUCTURES 9

Concurrent hashing – closed-address hash sets – lock-free hash sets – open-addressed hash sets – lock-based concurrent skip lists – lock-free concurrent skip lists – concurrent priority queues – bounded priority queue – unbounded priority queue – concurrent heap – skip list based unbounded priority queues.

Unit-V ADVANCED ALGORITHMS 9

Introduction to Approximation algorithms: Vertex cover - Travelling Salesman Problem – knapsack problem. Introduction to Randomized algorithms – Randomized Searching and Sorting - Online hiring problem. Introduction to Parallel algorithms – parallel sorting algorithms - Odd-even transposition sort - Quick sort based parallel sort.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S.K. Chang	Data Structures and Algorithms – Series of Software Engineering and Knowledge Engineering.	World Scientific Publishing	2003
2.	M. Herlihy and N. Shavit, Morgan Kaufmann	The Art of Multiprocessor Programming	Pearson education	2012
3.	E. Horowitz, S.Sahni and Dinesh Mehta	Fundamentals of Data structures in C++	Universities Press	2007
4.	Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein	Introduction to Algorithms	Prentice Hall of India, New Delhi	2007
5.	Michael J. Quinn	Parallel Computing: Theory & Practice	Tata McGraw Hill Edition.	2003

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23CSB02	ADVANCED DATASTRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- Understand the concept of linear and nonlinear data structures
- Implement Various operations of tree concept
- Design and analyze and Concepts of different types of heap
- Analyze hashing , probing methods like linear probing and quadratic probing tree
- Identify suitable data structure to solve various computing problems

Course Outcomes:

23CSB02.CO1	Design and implement Stack operation and double ended Queue.
23CSB02.CO2	Implement Tree operations in Binary search tree and red black tree.
23CSB02.CO3	Perform the operations on Fibonacci tree and Binomial tree Operation.
23CSB02.CO4	Apply hashing function to implement hash Data Structure and Implement Binary search tree.
23CSB02.CO5	Analyze greedy algorithm and divide and conquer technique and implement quick sort and travelling sales man problem.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB02.CO1	X	X	X	-	-	-	-	-	-	-	-	-	X	X	-
23CSB02.CO2	X	X	X	-	-	-	-	-	-	-	-	-	X	X	-
23CSB02.CO3	-	X	X	-	X	-	-	-	-	-	-	-	X	X	-
23CSB02.CO4	X	-	X	-	X	-	-	-	-	-	-	-	X	X	-
23CSB02.CO5	-	-	X	X	X	-	-	-	-	-	-	-	X	X	-

Sl.No.	List of Experiments
1.	Implement Stacks of size m with all the basic operations such as Is Empty(i),Push(i), Pop(i), IsFull(i) where i denotes the element in a stack
2.	Design and implement double ended Queue and its operations using Linked List
3.	Beginning with an empty binary search tree, Construct binary search tree by inserting the values in the order given. After constructing a binary tree – i. Insert new node ii. Find number of nodes in longest path iii. Minimum data value found in the tree iv. Search a value
4.	Implement a Red Black tree Operation
5.	Implement Fibonacci tree Operation – i. Create Fibonacci tree ii. Insert new node in Fibonacci tree iii. Get Minimum value
6.	Implement Binomial tree Operation – i. Create Binomial tree ii. Insert new node in Binomial tree iii. Get Minimum value

7. Write a program to store k keys into an array of size n at the location computed using a hash function, loc =key % n, where k<=n and k takes values from [1 to m], m>n.

8. Beginning with an empty binary search tree, Construct min priority Queue by inserting the values in the order given. After constructing a priority tree –
   i. Insert new node
   ii. Delete a given node
   iii. Find Min value node in a priority queue tree

9. Implement Program for Travelling Salesman Problem

10. Implement QuickSort on 1D array of Student structure(contains studentname, student_roll_no, total marks), with key as student_roll_no

Total Periods: 30

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23CSB03	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objective:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances
- Explore supervised and unsupervised learning paradigms of machine learning
- To explore Deep learning technique and various feature extraction strategies
- To learn the concept of how to learn patterns and concepts from data without being explicitlyprogrammed in various IOT nodes

Course Outcomes:

23CSB03.C01 Identify the perspectives of machine learning.

23CSB03.C02 Apply decision tree and Artificial neural networks for real world problems.

23CSB03.C03 Design a Bayesian classifier for solving a problem.

23CSB03.C04 Illustrate the principles of instance based learning and genetic algorithm.

23CSB03.C05 Describe the algorithms for rule and reinforcement learning.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB03.CO1	X	X	X	X	-	X	-	-	X	X	-	X	X	-	X
23CSB03.CO2	X	X	X	X	-	-	X	-	-	-	X	X	-	X	-
23CSB03.CO3	X	X	X	-	-	X	-	-	-	-	X	-	X	-	X
23CSB03.CO4	X	X	X	-	X	-	-	-	X		-	X	-	X	-
23CSB03.CO5	X	X	X	-	-	X	-	X	-	X	X	-	X	-	X

Unit-I INTRODUCTION 9

Learning Problems - Designing a Learning System - Perspectives and Issues in Machine Learning – Concept Learning – task – search – finding maximally specific Hypotheses – version spaces and candidate elimination algorithm- inductive bias.

Unit-II DECISION TREE LEARNING AND ARTIFICIAL NEURAL NETWORKS 9

Decision Tree Representation – Problems – basic decision tree learning algorithms – hypotheses search – Issues – Artificial Neural Networks: Introduction – Representations – Problems – Perceptrons – Multilayer networks and Back Propagation Algorithm – example.

Unit-III BAYESIAN LEARNING 9

Bayes Theorem – Concept Learning – Maximum Likelihood and Least-Squared Error Hypothesis - Maximum Likelihood Hypotheses for Predicting Probabilities - Bayes Optimal Classifier - Gibbs Algorithm - Naïve Bayes Classifier – Example.

Unit-IV INSTANCE BASED LEARNING AND GENETIC ALGORITHM 9

Introduction – k-Nearest Neighbour Learning – Locally Weighted Regression - Radial Basis Functions - Case- Based Reasoning. Genetic Algorithm – Example – Hypothesis Space Search – Genetic Programming- Models of Evolution and Learning – Parallelizing Genetic Algorithms.

Unit-V LEARNING SETS OF RULES 9

Learning sets of rules: Introduction – sequential covering algorithms – First order rules – FOIL – Induction as Inverted deduction – inverting resolution – Reinforcement learning – Introduction – Learning task – Q learning

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Tom M. Mitchell	Machine Learning	Indian Edition, McGraw-Hill Education (India)	2013
2.	Simon Rogeres and Mark Girolami	A First Course in Machine Learning	CRC Press	2015
3.	Ethem Alpaydin	Introduction to Machine Learning	3rd Edition, Prentice Hall India	2015
4.	Christopher Bishop	Pattern Recognition and Machine Learning	Springer	2007

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23CSB04	MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To understand the concept of algorithms and illustrate the hypothesis using sets of trained data
- To learn and understand the concept of building the decision tree and Artificial neural networks using sample data sets
- To evaluate and understand the concept of Bayesian classifier using sample trained data sets
- To understand the EM algorithm and k-mean algorithms using trained data set
- To understand the concept of Regression algorithm and nearest neighbor algorithm

Course Outcomes:

23CSB04.CO1	Identify the algorithms for trained data samples.
23CSB04.CO2	Understanding the concept of decision tree and Artificial neural networks.
23CSB04.CO3	Develop the sample data sets by calculating the accuracy, precision and recall.
23CSB04.CO4	Compare the results of two different algorithms based on ML library classes and API.
23CSB04.CO5	Implement the algorithm for data sets based on predictions using data graph in order to fit the data points.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB04.CO1	X	X	X	-	X	X	-	X	X	X	-	X	X	X	X
23CSB04.CO2	X	X	X	X	X	X	-	-	X	-	-	X	X	X	-
23CSB04.CO3	X	X	X	-	X	-	X	-	-	X	X	X	X	-	X
23CSB04.CO4	X	X	X	X	X	-	-	X	-	X	X	X	-	X	-
23CSB04.CO5	X	X	X	X	X	-	X	-	X	-	X	X	-	X	X

Sl.No.	List of Experiments
1.	Implement and demonstrate the FIND S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate
3.	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an Appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4.	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets
5.	Write a program to 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.
6.	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7.	Write a program to construct a Bayesian network considering medical data. Use this model to Demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering sing k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Total Periods: 30

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23CSB05	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Course Objective:

- To learn how to apply trust-based security model to real-world security problems
- To study the concepts, processes and best practices needed to successfully secure information
- Within Cloud infrastructures
- To know the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and challenges for each Cloud type and service delivery model

Course Outcomes:

23CSB05.CO1 Identify security aspects of each cloud model.

23CSB05.CO2 Develop a risk-management strategy for moving to the cloud.

23CSB05.CO3 Implement a public cloud instance using a public cloud service provider.

23CSB05.CO4 Apply trust based security model to different layer.

23CSB05.CO5 Examine the concept of audit and compliance.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB05.CO1	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-
23CSB05.CO2	X	X	X	-	X	-	-	-	-	-	X	-	-	X	-
23CSB05.CO3	X	X	X	-	-	-	-	-	-	-	X	-	X	-	-
23CSB05.CO4	X	X	X	-	X	X	-	-	-	-	-	X	-	X	-
23CSB05.CO5	X	-	-	-	X	-	-	-	-	-	X	X	X	-	-

Unit-I BASICS OF CLOUD COMPUTING 9

Online Social Networks and Applications – Cloud introduction and overview –Different clouds – Risks – Novel applications of cloud computing–Cloud Computing Architecture: Requirements – Introduction Cloud computing architecture –On Demand Computing Virtualization at the infrastructure level –Security in Cloud computing environments – CPU Virtualization –Hypervisors Storage Virtualization Cloud Computing Defined – SPI Framework for Cloud Computing –Traditional Software Model– Cloud Services Delivery Model.

Unit-II CLOUD DEPLOYMENT MODELS AND SECURITY ISSUES 9

Key Drivers to Adopting the Cloud – The Impact of Cloud Computing on Users –Governance in the Cloud – Barriers to Cloud Computing Adoption In the Enterprise. Infrastructure Security: The Network Level – The Host Level – The Application Level – Data Security and Storage – Aspects of Data Security – Data Security Mitigation Provider Data and Its Security.

Unit-III ACCESS AND SECURITY MANAGEMENT 9

Identity and Access Management: Trust Boundaries and IAM – IAM Challenges – Relevant IAM Standards and Protocols for Cloud Services – IAM Practices in the Cloud – Cloud Authorization Management. Security Management in the Cloud: Security Management Standards – Security Management in the Cloud – Availability Management: SaaS, PaaS, IaaS.

Unit-IV PRIVACY ISSUES 9

Privacy Issues – Data Life Cycle – Key Privacy Concerns in the Cloud – Protecting Privacy – Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing – Legal and Regulatory Implications – U.S. Laws and Regulations – International Laws and Regulations.

Unit-V AUDIT AND COMPLIANCE 9

Internal Policy Compliance – Governance – Risk and Compliance (GRC) –Regulatory/External Compliance – Cloud Security Alliance – Auditing the Cloud for Compliance – Security-as-a-Cloud.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John Rhoton	Cloud Computing Explained: Implementation Handbook forEnterprises	Amazon.com	2009
2.	Tim Mather	Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)	O'Reilly Media	2009
3.	Rajkumar Buyya	Christian Vecchiola, and ThamaraiSelvi, "Mastering Cloud Computing"	Tata McGraw Hill Edition	2013
4.	Tom White	Hadoop: The Definitive Guide	Yahoo Press	2012

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23CSB06	CLOUD COMPUTING LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To learn how to apply trust-based security model to real-world security problems
- To study the concepts, processes and best practices needed to successfully secure information within Cloud infrastructures
- To know the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and challenges for each Cloud type and service delivery model

Course Outcomes:

23CSB06.CO1 Identify security aspects of each cloud model.

23CSB06.CO2 Develop a risk-management strategy for moving to the cloud.

23CSB06.CO3 Implement a public cloud instance using a public cloud service provider

23CSB06.CO4 Apply trust based security model to different layer.

23CSB06.CO5 Examine the concept of audit and compliance.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB06.CO1	X	X	X		-	X	-	-	-	-	-	-	X	-	-
23CSB06.CO2	X	X	X	-	X	-	-	-	-	-	X	-	-	X	-
23CSB06.CO3	X	X	X	-	-	-	-	-	X	-	X	-	X	-	-
23CSB06.CO4	X	X	-	X	-	X	-	-	-	-	-	X	-	X	-
23CSB06.CO5	X	-	-	-	X	-	-	X	-	-	X	X	X	-	-

Sl.No.	List of Experiments
1.	a) Installation of various hypervisors and instantiation of VMs with image file using open source Hypervisors such as Virtual Box, VMWare Player, Xen and KVM. b) Client server communication between two virtual machine instances, execution of chat application
2.	Creation of simple network topology using open source network virtualization tools (like mini net and Others).
3.	Implementation of simple network protocols using open source network controllers (like Open Daylight).
4.	Implementation of various scheduling mechanisms using open source cloud simulator.
5.	Familiarization and usage of the following cloud services with open source cloud tools(like Eucalyptus, Open stack, Open Nebula and others) a) Scheduling mechanisms b) Load balancing mechanisms c) Hashing and encryption mechanisms
6.	Familiarization and usage of collaborative applications (SaaS).
7.	Implementing applications using Google App Engine (PaaS).
8.	Develop Map Reduce application (example-URL Pattern count and others) using Hadoop cluster set up (Single node and multi node).

Total Periods: 30

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23CSB07	ADVANCED OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To learn the fundamentals of Operating Systems
- To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
- To gain insight on to the distributed resource management components
- To know the components of Real time, Mobile operating systems
- To learn the management aspects of Mobile operating systems

Course Outcomes:

23CSB07.CO1	Discuss the various synchronization, scheduling and memory management issues.
23CSB07.CO2	Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed Operating system.
23CSB07.CO3	Discuss the various resource management techniques for distributed systems.
23CSB07.CO4	Identify the different features of real time and mobile operating systems.
23CSB07.CO5	Ability To Learn the management aspects of Mobile operating systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB07.CO1	X	X	X	-	-	-	-	-	X	X	-	X	-	X	-
23CSB07.CO2	X	X	X	-	X	-	-	-	X	-	X	-	X	-	X
23CSB07.CO3	X	X	X	-	-	-	-	-	X	X	-	-	X	X	-
23CSB07.CO4	X	X	X	-	-	-	-	-	-	-	X	X	-	X	X
23CSB07.CO5	X	X	X	-	X	-	-	-	X	X	X	-	X	X	X

Unit-I FUNDAMENTALS OF OPERATING SYSTEMS 9

Overview – Synchronization Mechanisms – Processes and Threads - Process Scheduling – Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques

Unit-II DISTRIBUTED OPERATING SYSTEMS 9

Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols

Unit-III DISTRIBUTED RESOURCE MANAGEMENT 9

Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Non blocking Commit Protocol – Security and Protection.

Unit-IV REAL TIME AND MOBILE OPERATING SYSTEMS 9

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –Micro Kernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File system.

Unit-V CASE STUDIES 9

Linux System: Design Principles - Kernel Modules - Process Management Scheduling - Memory Management - Input-Output Management - File System – Inter process Communication. iOS and Android: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mukesh Singhal and Niranjan G. Shivaratri	Advanced Concepts in OperatingSystems – Distributed, Database, and MultiprocessorOperating Systems	Tata McGraw-Hill	2001
2.	Abraham Silberschatz; Peter Baer Galvin; GregGagne	Operating System Concepts	John Wiley &Sons	2004
3.	Daniel P Bovet and MarcoCesati	Understanding the LinuxKernel	O'Reilly	2005
4.	Singhal	Advanced concepts in operating systems	Tata McGraw-Hill Education	2001
5.	Dang Van Duc	Operating System	Institute of Information Technology	2012

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23CSB08	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3

Course Objective:

- Learn digital image fundamentals
- Be familiar with image enhancement techniques in spatial and frequency domain
- Be familiar with image compression and segmentation techniques and morphological image processing
- Understand the concept of image representation and description
- Learn to recognition image in form of features

Course Outcomes:

23CSB08.CO1 Explain the fundamentals of Digital image and its Processing.

23CSB08.CO2 Perform Image Enhancement Techniques in spatial and frequency domain.

23CSB08.CO3 Apply the concept of image segmentation and Morphological Image processing.

23CSB08.CO4 Use various image Representation and Description techniques.

23CSB08.CO5 Describe Object detection and Recognition Techniques.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB08.CO1	X	-	-	-	X	-	-	-	-	-	X	X	-	X	-
23CSB08.CO2	X	X	X	-	X	-	-	-	-	-	X	X	-	X	-
23CSB08.CO3	X	X	X	-	X	-	-	-	-	-	X	X	-	X	-
23CSB08.CO4	X	X	X	-	X	-	-	-	-	-	X	X	-	X	-
23CSB08.CO5	X	X	X	X	X	-	-	-	-	-	X	X	-	X	-

Unit-I INTRODUCTION TO IMAGE PROCESSING AND COMPUTER 9

Introduction, Digital Image Fundamentals, image acquisition and display using digital devices - Human visual perception, properties–Image Formation-Image sampling and quantization - Basic relationship between pixels.

Unit-II IMAGE ENHANCEMENT 9

Image enhancement in the spatial domain: basic grey level transformation, Histogram Processing - Enhancement using arithmetic/Logic operations – Spatial filtering: smoothing and sharpening.
Image enhancement in the frequency domain: Introduction to two - dimensional transforms- Discrete Fourier Transform, Discrete Cosine Transform, Discrete Wavelet Transform – smoothing frequency domain filtering - sharpening frequency domain filtering

Unit-III MORPHOLOGICAL IMAGE PROCESSING AND IMAGE SEGMENTATION 9

Morphological Image Processing: Dilation and Erosion –Opening and Closing – Hit or Miss Transformation – Basic morphological algorithm Image Segmentation: Detection of discontinuities- Object Detection Methods, Edge Liking and Boundary Detection, Thresholding Methods, Region Oriented Methods.

Unit-IV REPRESENTATION AND DESCRIPTION 9

Chain codes, Polygonal approximation, Signature Boundary Segments, Skeletons, Boundary Descriptors, Regional Descriptors, Some Simple Descriptors Topological Descriptors Texture Moment Invariants Use of Principal Components for Description Relational Descriptors.

Unit-V OBJECT RECOGNITION 9

Patterns and Pattern Classes Recognition Based on Decision-Theoretic Methods Optimum Statistical Classifiers Neural Networks Matching Biological Neural Network, McCulloch Pitts Neuron, Thresholding Logic, Perceptron, Perceptron Learning Matching Shape Numbers String Matching Algorithm Feed forward Neural Network, Back propagation Neural Network

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rafael C.Gonzalez , Richard E. Woods	Digital Image Processing	Pearson Education, Third Edition	2013
2.	A.K. Jain	Fundamentals of Digital Image Processing.	Prentice Hall India	1988

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David A .Forsyth , Jean Ponce	Computer Vision : A Modern Approach	Prentice Hall ; Second edition	2011
2.	Scott E Umbaugh	Digital Image Processing and Analysis: Human and Computer Vision Application with CVIP tools	Second Edition, CRC Press	2011

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23CSB09	IMAGE PROCESSING AND ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- Be exposed to simple image processing techniques
- Be familiar with image enhancement and segmentation techniques
- Be familiar with morphological and image transform

Course Outcomes:

23CSB09.CO1 Perform the image enhancement and edge detection.

23CSB09.CO2 Implement Morphological operation.

23CSB09.CO3 Demonstrate image transform and Color image processing.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB09.CO1	X	-	-	-	X	-	-	-	-	-	X	X	-	X	-
23CSB09.CO2	X	X	X	-	X	-	-	-	-	-	X	X	-	X	-
23CSB09.CO3	X	X	X	-	X	-	-	-	-	-	X	X	-	X	-

Sl.No.	List of Experiments
1.	Program to enhance image using image arithmetic and logical operations.
2.	Program for image enhancement using histogram equalization.
3.	Program for image enhancement using Image Negative and Gray level slicin
4.	Program to filter an image using averaging low pass filter in spatial domain and median filter.
5.	Program for smooth an image using low pass filter in frequency domain.(Butterworth lpf)
6.	Program for smooth an image using high pass filter in frequency domain.(Butterworth hpf)
7.	Program for morphological image operations-erosion, dilation, opening &closing.
8.	Program for edge detection algorithm.
9.	To fill the region of interest for the image.
10.	Program of sharpen image using gradient mask.

Total Periods: 30

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23CSB10	SOFT COMPUTING	L	T	P	C
		3	0	0	3

Course Objective:

- Classify the various soft computing frame works
- Be familiar with the design of neural networks, fuzzy logic and fuzzy systems
- Learn mathematical background for optimized genetic programming
- Be exposed to neuro-fuzzy hybrid systems and its applications

Course Outcomes:

23CSB10.CO1 Apply various soft computing concepts for practical applications.

23CSB10.CO2 Choose and design suitable neural network for real time problems.

23CSB10.CO3 Use fuzzy rules and reasoning to develop decision making and expert system.

23CSB10.CO4 Explain the importance of optimization techniques and genetic programming.

23CSB10.CO5 Review the various hybrid soft computing techniques and apply in real time problems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB10.CO1	X	-	X	-	-	-	-	-	-	-	-	X	X	-	-
23CSB10.CO2	X	X	-	-	-	-	-	X	-	-	-	X	X	X	-
23CSB10.CO3	X	X	-	X		-	-	-	-	-	-	X	-	X	X
23CSB10.CO4	X	X	X	X	X	-	-	-	X	X	X	-	-	-	X
23CSB10.CO5	X	X	X	X	X	-	-	-	-	-	X	X	-	-	X

Unit-I INTRODUCTION TO SOFT COMPUTING 9

Soft Computing Constituents-From Conventional AI to Computational Intelligence- Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks - basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts

Unit-II NEURAL NETWORKS 9

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative auto associative memory network & iterative associative memory network –unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks, ART network.

Unit-III FUZZY LOGIC 9

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

Unit-IV GENETIC ALGORITHM 9

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators – Encoding scheme – Fitness evaluation – crossover - mutation - genetic programming – multilevel optimization – real life problem- advances in GA .

Unit-V HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 9

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	J.S.R.Jang, C.T. Sun and E.Mizutani	Neuro-Fuzzy and SoftComputing	PHI / Pearson Eduaction	2004
2.	S.N.Sivanandam and S.N.Deepa	Principles of Soft Computing	Wiley India Pvt Ltd	2011
3.	S.Rajasekaran and G.A.Vijayalakshmi Pai	Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and Applications	Prentice-Hall of IndiaPvt. Ltd.,	2006
4.	George J. Klir, Ute St. Clair, Bo Yuan,	Fuzzy Set Theory	Foundations and Applications Prentice Hall,	1997
5.	David E. Goldberg	Algorithm in Search Optimization and Machine Learning	Genetic Pearson Education India	2013
6.	James A. Freeman, David M. Skapura	Neural Networks Algorithms, Applications, and Programming Techniques	Pearson EducationIndia	1991
7.	Simon Haykin	Neural Networks	Comprehensive Foundation Second Edition Pearson Education	2005

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23CSB11	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

Course Objective:

- To learn the basics of research problem, effective technical writing and developing a research proposal
- To study about Nature of Intellectual Property and Patent Rights

Course Outcomes:

23CSB11.CO1	Understand research problem formulation.
23CSB11.CO2	Analyze research related information
23CSB11.CO3	Follow research ethics.
23CSB11.CO4	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
23CSB11.CO5	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB11.CO1	X	-	-	X	-	-	X	-	X	-	X	-	-	X	-
23CSB11.CO2	-	X	-	-	X	-	-	X	-	-	X	-	X	-	-
23CSB11.CO3	-	X	-	X	-	X	X	-	-	-	X	-	-	-	-
23CSB11.CO4	-	X	X	-	X	-	-	-	X	-	-	X	-	-	-
23CSB11.CO5	-	-	X	-	X	-	-	-	X	-	X	-	-	X	-

Unit-I BASICS OF RESEARCH PROBLEM 9

Meaning of research problem – Sources of research problem – Criteria Characteristics of a good research problem – Errors in selecting a research problem – Scope and objectives of research problem. Approaches of investigation of solutions for research problem – Data collection – Analysis – Interpretation – Necessary instrumentations

Unit-II TECHNICAL WRITING AND PROPOSAL 9

Effective literature studies approaches – Analysis Plagiarism – Research ethics – Effective technical writing – How to write Report – Paper – Developing Research Proposal – Format of research proposal – Presentation and Assessment by a review committee.

Unit-III INTELLECTUAL PROPERTY 9

Nature of Intellectual Property: Patents – Designs –Trade and Copyright. Process of Patenting and Development: Technological research – Innovation – Patenting – Development. International Scenario: International cooperation on Intellectual Property – Procedure for grants of patents – Patenting under PCT.

Unit-IV PATENT RIGHTS 9

Patent Rights: Scope of Patent Rights – Licensing and transfer of technology – Patent information and databases – Geographical Indications.

Unit-V DEVELOPMENTS IN IPR 9

New Developments in IPR: Administration of Patent System – New developments in IPR – IPR of Biological Systems – Computer Software – Traditional knowledge Case Studies – IPR and IITs.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Wayne Goddard and Stuart Melville	Research methodology: an introduction for science & engineering students	Juta and Company Ltd,2nd Edition	2004
2.	Ranjit Kumar	Research Methodology: A Step by Step Guidefor beginners	2nd Edition	2004
3.	Halbert	Resisting Intellectual Property	Taylor & Francis Ltd	2007
4.	Mayal	Industrial Design	McGraw Hill	1992
5.	Niebel	Product Design	McGraw Hill	1974
6.	Asimov	Introduction to Design	Prentice Hall	1962
7.	Robert P. Merges, Peter S.Menell, Mark A. Lemley,	IntellectualProperty in New Technological Age	McGraw Hill	2016

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23CSB12	DATA MINING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objective:

- To learn the fundamentals of Data mining
- To gain knowledge on association rule concepts in real time systems
- To gain insight on various classification
- To gain insight on different clustering methods
- To study the different types of tools for complex mining techniques

Course Outcomes:

23CSB12.CO1 Apply the functionalities of data mining in real time applications.

23CSB12.CO2 Do the preprocessing and apply association rule concepts in real time systems.

23CSB12.CO3 Implement the various classification.

23CSB12.CO4 Implement the different clustering methods.

23CSB12.CO5 Study the different tools for complex mining techniques.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB12.CO1	X	X	X	-	-	-	-	-	X	X	X	X	X	-	X
23CSB12.CO2	X	X	X	-	-	X	-	-	X	X	X	X	-	-	-
23CSB12.CO3	X	X	X	-	X	-	-	-	X	-	X	X	X	X	-
23CSB12.CO4	X	X	X	-	X	-	-	-	X	-	X	X	X	X	-
23CSB12.CO5	X	X	X	-	X	-	-	-	X	X	X	-	X	-	X

Unit-I INTRODUCTION 9

Data Mining-Steps in Knowledge Discovery Process- Kinds of Data and Patterns – Technologies used-Targeted applications - Major issues in Data Mining - Data objects and attribute types - Statistical descriptions of data - Data Visualization- Measuring data similarity and dissimilarity.

Unit-II DATA PREPROCESSING 9

Data Cleaning, Integration, Reduction, Transformation and Discretization, Mining Frequent Patterns – Frequent Item set Mining Methods

Unit-III CLASSIFICATION 9

Decision Tree Induction-Bayesian Classification - Rule based Classification - classification by Back Propagation – Support Vector Machines – Lazy Learners – Model Evaluation and Selection – Techniques to improve Classification Accuracy - k-Nearest Neighbor Classifier.

Unit-IV CLUSTER ANALYSIS 9

Clusters Analysis: Partitioning Methods – Hierarchical Methods – Density based Methods – Grid based Methods - Evaluation of Clustering – Outliers and Outlier analysis – Outlier detection Methods - Statistical Approaches

Unit-V APPLICATIONS 9

Rules - Knowledge Bases - Active And Deductive Databases - Parallel Databases - Multimedia Databases - Image Databases - Text Database Mining Complex data types - Statistical Data Mining - Data Mining foundations – Visual and Audio Data Mining – Applications - Ubiquitous and invisible Data Mining - Social impacts of Data Mining .

Total Periods: 45

Reference Book

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jiawei Han Micheline Kamber	Data Mining Concepts and Techniques	3rd Edition, Elsevier	2011
2.	Alex Berson, Stephen J. Smith	Data Warehousing, Data Mining & OLAP	Tata McGraw Hill	2007
3.	K.P. Soman, Shyam Diwakar	Insight into Data mining Theory and Practice	2nd Edition, Prentice Hall of India	2006
4.	G. K. Gupta	Introduction to Data Mining with Case Study	Prentice Hall ofIndia	2011
5.	Pang-Ning Tan, MichaelSteinbach Vipi Kumar	Introduction to Data Mining	2ndEdition,Pearson	2007

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23CSB13	NETWORK DESIGN AND TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the fundamental concepts of computer networks
- To understand the design of Network architectures
- To understand the working principles of different protocols in various layers
- To study the implementation concepts in congestion control
- To study the implementation concepts in error detections

Course Outcomes:

23CSB13.CO1 Familiar with the basics of Computer Networks.

23CSB13.CO2 Understand Network architectures.

23CSB13.CO3 Understand Concepts of fundamental protocols.

23CSB13.CO4 Understand the knowledge of internetworking concepts in various applications.

23CSB13.CO5 Ability to study the implementation concepts in error detections.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB13.CO1	X	X	-	-	X	-	X	-	-	-	-	X	X	-	X
23CSB13.CO2	-	-	X	X	-	X	-	-	X	-	-	-	-	-	X
23CSB13.CO3	X	-	X	-	X	-	-	-	-	X	-	-	X	-	-
23CSB13.CO4	-	X	-	X	X	-	-	X	-	-	-	X	-	X	-
23CSB13.CO5	-	-	X	X	X	-	-	-	X	-	-	-	-	-	X

Unit-I NETWORK DESIGN FUNDAMENTALS 9

Introduction - Cooperative communications -The OSI model -The TCP/IP model -The Internet protocols- Networking hardware-Physical connectivity-Virtual connectivity.

Unit-II NETWORK MONITORING AND ANALYSIS 9

Network monitoring and Analysis: An effective network monitoring LAN and WAN - Monitoring your network -The dedicated monitoring server – monitoring various network parameters - characteristics of monitoring tools - Types of monitoring tools-Spot check tools-Log analyzers-Trending tools-Real time tools- Benchmarking-Interpret the traffic graph - Monitoring RAM and CPU usage.

Unit-III 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.

Unit-IV 4G AND 5G NETWORKS 9

4G and 5G Networks : 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 – Introduction to 5G.

Unit-V SOFTWARE DEFINED NETWORKS 9

Software Defined Networks: Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers.

Total Periods: 45

Reference Book

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Martin Sauter	From GSM to LTE, An Introduciton to Mobile Networks and Mobile Broadband	1st Edition,Wiley	2014
2.	Thoman D. Nadeau, andKen Gray	SDN - Software Defined Networks	1st Edition, O"Reilly Publishers	2013

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23CSB14	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

- To realize the relationship between UML diagrams
- To design and test software project
- To understand the concept of system design
- To understand the concept of object design
- To understand the concepts of testing

Course Outcomes:

23CSB14.CO1	Execute the software project using software engineering methodologies.
23CSB14.CO2	Design various UML diagrams and inter relate them.
23CSB14.CO3	Design, test and manage the software project using various tools.
23CSB14.CO4	Analyze the concept of system design.
23CSB14.CO5	Analyze the concept of object design.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB14.CO1	X	X	-	-	-	-	-	-	-	-	-	-	X	X	-
23CSB14.CO2	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-
23CSB14.CO3	X	-	-	X	X	-	-	-	-	-	-	-	-	X	-
23CSB14.CO4	X	-	X	X	-	-	-	-	X	-	-	X	-	X	X
23CSB14.CO5	-	-	X	X	X	-	-	-	X	-	-	X	X	-	X

Unit-I INTRODUCTION SOFTWARE ENGINEERING 9

Software engineering concepts -Software engineering development activities - Managing software development - Introduction to UML- Modeling concepts – UML diagrams - Project organizations - Project communication concepts- Organizational activities

Unit-II REQUIREMENTS ELICITATION AND ANALYSIS 9

An overview of requirements elicitation – Requirements elicitation concepts - Requirements elicitation activities - Managing requirements elicitation - Analysis overview – Concepts of analysis - Activities: from use cases to objects- Managing analysis

Unit-III SYSTEM DESIGN AND OBJECT DESIGN 9

Decomposing the system- An overview of system design - System design concepts - System design activities – From objects to subsystems - Addressing design goals - Managing system design - Object design - Reusing pattern solutions - Reuse concepts - Solution objects – Inheritance - Design patterns - Reuse activities - Managing reuse

Unit-IV TESTING AND MANAGING CHANGES 9

Testing concepts - Testing activities - Component inspection- Managing testing - Rationale management – Rationale concepts - Rationale activities - From issues to decisions - Managing rationale heuristics for communicating about rationale - Issue modeling and negotiation - Conflict resolution strategies.

Unit-V CONFIGURATION MANAGEMENT AND PROJECT MANAGEMENT 9

Configuration management concepts - Configuration management activities - Managing configuration management- Project management - Project management concepts - Classical project management activities - Agile project management activities.

Total Periods: 45

Reference Books:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sommer ville	Software Engineering	Pearson Education	2009
2.	Roger S. Pressman	Software Engineering - A Practitionar's Approach	McGraw-Hill International Edition,	2012
3.	Robert N.Britcher	The Limits of Software: People, Projects, and Perspectives	Addison-Wesley Pub Co;1st edition	2007
4.	Frederick P.Brooks	Essays on Software Engineering,	Addison-Wesley Pub Co;1st edition	2005
5.	Richard H. Thayer	Requirements Engineering: A GoodPractice Guide	Software Requirement Engineering.	2007

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23CSB15	ADVANCED DATABASE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective:

- To understand database systems, data models, database languages
- To be able to design a database system by understanding the concepts of functional dependencies and normalization
- To acquire the knowledge on its query processing
- To understand the principles of object oriented databases
- To gain knowledge about the emerging database technologies

Course Outcomes:

23CSB15.CO1 Study the database systems, data models, database languages.

23CSB15.CO2 Able to design a database system by understanding the concepts of functional dependencies and normalization.

23CSB15.CO3 Apply the knowledge on its query processing.

23CSB15.CO4 Analyze the principles of object oriented databases.

23CSB15.CO5 Study about the different emerging database technologies.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
23CSB15.CO1	X	X	-	-	-	-	-	-	-	-	-	-	X	X	-
23CSB15.CO2	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-
23CSB15.CO3	X	-	-	X	X	-	-	-	-	-	-	-	-	X	-
23CSB15.CO4	X	-	X	X	-	-	-	-	X	-	-	X	-	X	X
23CSB15.CO5	-	-	X	X	X	-	-	-	X	-	-	X	X	-	X

Unit-I DISTRIBUTED DATABASES 9

Distributed Databases Vs Conventional Databases - Architecture - Fragmentation - Query Processing - Transaction Processing - Concurrency Control - Recovery.

Unit-II OBJECT ORIENTED DATABASES 9

Introduction to Object Oriented Data Bases - Approaches - Modeling and Design - Persistence - Query Languages - Transaction - Concurrency - Multi Version Locks – Recovery

Unit-III EMERGING SYSTEMS 9

Enhanced Data Models - Client/Server Model - Data Warehousing and Data Mining - Web Databases - Mobile Databases.

Unit-IV DESIGN DATABASE ISSUES 9

ER Model - Normalization - Security - Integrity - Consistency - Database Tuning - Optimization and Research Issues - Design of Temporal Databases - Spatial Databases.

Unit-V CURRENT ISSUES 9

Rules - Knowledge Bases - Active And Deductive Databases - Parallel Databases - Multimedia Databases - Image Databases - Text Database

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Elisa Bertino, Barbara Catania, Gian Piero Zarri	Intelligent Database Systems	Addison-Wesley	2001
2	Carlo Zaniolo, Stefano Ceri, Christos Faloustsos, R.T.Snodgrass, V.S.Subrahmanian	Advanced Database Systems	Pearson Publication	1997
3	Morgan KaufmanN.Tame Ozsu, Patrick Valduriez	Principles Of Distributed Database Systems	Prentice Hall International Inc	1999
4	Abdullah Uz Tansel Et Al	Temporal Databases: Theory, Design and Principles	Benjamin Cummings Publishers	1993
5	Raghu Ramakrishnan, Johannes Gehrke	Database Management Systems	McGraw Hill, Third Edition	2004

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23CSB16	ADVANCED DATABASE TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To understand database systems, data models, database languages
- To be able to design a database system by understanding the concepts of functional dependencies and Normalization
- To acquire the knowledge on its query processing
- To understand the principles of object oriented databases
- To gain knowledge about the emerging database technologies

Course Outcomes:

23CSB16.CO1	Study the database systems, data models, database languages.
23CSB16.CO2	Able to design a database system by understanding the concepts of functional dependencies and normalization.
23CSB16.CO3	Apply the knowledge on its query processing.
23CSB16.CO4	Analyze the principles of object oriented databases.
23CSB16.CO5	Study about the different emerging database technologies.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB16.CO1	-	X	X	X	X	-	-	-	X	-	X	-	-	-	X
23CSB16.CO2	-	-	X	X	X	-	-	-	X	-	X	-	-	-	X
23CSB16.CO3	-	-	X	X	X	-	-	-	X	-	X	-	-	-	X
23CSB16.CO4	-	-	X	X	X	-	-	-	X	-	X	-	-	-	X
23CSB16.CO5	-	-	X	X	X	-	-	-	X	-	X	-	-	-	X

Sl.No.	List of Experiments
1.	Implement parallel sorting and aggregates
2.	Implement parallel joins and Hash joins
3.	Implement semi join and bloom join in distributed DBMS
4.	Implement two phase commit in distributed DBMS
5.	Implementation of cube operator in OLAP queries in data warehousing and decision support system
6.	Implement decision tree of data mining problem
7.	Implement a priori algorithm in data mining
8.	Simulation of a search engine
9.	Implement view modification and materialization in data warehousing and decision support systems
10.	Implementation of data log queries for deductive databases (Negation, Aggregate, Recursive etc.)

Total Periods: 30

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23CSB17	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the various algorithms for handling big data
- To understand the techniques for handling big data
- To learn No SQL database system
- To learn concepts for Data stream mining
- To analyse the stream computing

Course Outcomes:

23CSB17.CO1 Understand how to leverage the insights from big data analytics through various algorithms.

23CSB17.CO2 Analyze data by utilizing various statistical and data mining approaches.

23CSB17.CO3 Perform analytics on real time data using Hadoop related tools.

23CSB17.CO4 Comprehend the various methods for mining the data.

23CSB17.CO5 Analyze the concepts of real time data streaming.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB17.CO1	X	X	X	X	-	-	-	X	-	X	-	X	X	-	-
23CSB17.CO2	-	-	X	X	X	-	X	-	X	-	X	-	-	X	X
23CSB17.CO3	X	X		-	-	-	X	-		X			-	X	-
23CSB17.CO4	X	-	X	-	-	X		X		-	-	X	X	X	-
23CSB17.CO5	X	X	-	X	-	X	X	-	X	-	X	-	-	-	X

Unit-I BIG DATA **9**

Big Data: Definition – Wholeness of big data: Understanding – Capturing –Benefits and management – Organizing and analyzing – Challenges – Big data architecture – Big data sources and applications: Big data sources – Machine to machine Communications- Big data Applications.

Unit-II MAPREDUCE FRAMEWORK **9**

Introducing Hadoop – Starting Hadoop – Components of Hadoop: Working with files in HDFS - Anatomy of a MapReduce program – Reading and writing - Writing basic MapReduce programs: Getting the patent data set-Constructing the basic template of a MapReduce program-Counting things-Adapting for Hadoop‟sAPI changes-Streaming in Hadoop- Improving performance with combiners – Hadoop Ecosystem

Unit-III NOSQL DATABASE SYSTEMS **9**

Introduction to NoSQL – CAP theorem - MongoDB : Data types – MongoDB Query Language – Cassandra: Features of Cassandra- Data types – CRUD- Collections Alter Commands – Import and EXport- Querying system tables.

Unit-IV MINING DATA STREAMS **9**

Stream Data Model - Sampling Data in a Stream–Filtering Streams–Counting Distinct Elements in a Stream–Estimating Moments–Counting Ones in a Window–Decaying Window - Stream processing with SPARK and Kafka.

Unit-V CASE STUDIES **9**

Implement using open source frameworks/tools : Time Series Analysis - Text analysis – Social Network Analysis - Data streams

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Anil Maheshwari	Big Data	1 st Edition, McGrawHill Education	2017
2	Chuck Lam	Hadoop in Action	2 nd Edition, Manning Publications	2011
3	Seema Acharya and Subhashini Chellappan	Big Data and Analytics	1st Edition, Wiley	2015
4	Pfleeger & Pfleeger	Security in Computing	Pearson Education,3rd Edition	2003
5	Carmit Hazay, Yehuda Lindell	Efficient Secure TwoParty Protocols: Techniques andConstructions	Springer-Verlag	2010

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23CSB18	FOUNDATIONS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

Course Objective:

- To apply fundamental algorithms to process data
- Learn to apply hypotheses and data into actionable predictions
- Document and transfer the results and effectively communicate the findings using
- visualization techniques
- To learn statistical methods and machine learning algorithms required for Data Science
- To develop the fundamental knowledge and understand concepts to become a data science professional

Course Outcomes:

23CSB18.CO1	Obtain, clean/process and transform data.
23CSB18.CO2	Analyze and interpret data using an ethically responsible approach.
23CSB18.CO3	Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.
23CSB18.CO4	Apply computing theory, languages and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses.
23CSB18.CO5	Formulate and use appropriate models of data analysis to solve business-related challenges.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB18.CO1	X	X	X	X	-	-	-	X	-	X	-	X	X	-	-
23CSB18.CO2	-	-	X	X	X	-	X	-	X	-	X	-	-	X	X
23CSB18.CO3	X	X		-	-	-	X	-		X			-	X	-
23CSB18.CO4	X	-	X	-	-	X		X		-	-	X	X	X	-
23CSB18.CO5	X	X	-	X	-	X	X	-	X	-	X	-	-	-	X

Unit-I INTRODUCTION TO DATA SCIENCE 9

Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.

Unit-II MODELING METHODS 9

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods

Unit-III INTRODUCTION TO R 9

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.

Unit-IV MAPREDUCE 9

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

Unit-V DATA VISUALIZATION 9

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph using graphics parameters - Case studies.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nina Zumel, John Mount	Practical Data Science with R	Manning Publications	2014
2.	Mark Gardener	Beginning R - The Statistical Programming Language	John Wiley & Sons, Inc.	2012
3.	W. N. Venables, D. M. Smith and the R Core Team	An Introduction to R	-	2013
4.	Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta	Practical Data Science Cookbook	Packt Publishing Ltd	2014
5.	Nathan Yau	Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics	Wiley	2011

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23CSB19	COGNITIVE COMPUTING	L	T	P	C
		3	0	0	3

Course Objective:

- To familiarize Use the Innovation Canvas to justify potentially successful products
- To learn various ways in which to develop a product idea
- To understand about how Big Data can play vital role in Cognitive Computing
- To know about the business applications of Cognitive Computing
- To get into all applications of Cognitive Computing

Course Outcomes:

23CSB19.CO1 Explain applications in Cognitive Computing.

23CSB19.CO2 Describe Natural language processor role in Cognitive computing.

23CSB19.CO3 Explain future directions of Cognitive Computing.

23CSB19.CO4 Evaluate the process of taking a product to market.

23CSB19.CO5 Comprehend the applications involved in this domain.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB19.CO1	X	X	X	X	-	-	-	X	-	X	-	X	X	-	-
23CSB19.CO2	-	-	X	X	X	-	X	-	X	-	X	-	-	X	X
23CSB19.CO3	X	X		-	-	-	X	-		X			-	X	-
23CSB19.CO4	X	-	X	-	-	X		X		-	-	X	X	X	-
23CSB19.CO5	X	X	-	X	-	X	X	-	X	-	X	-	-	-	X

Unit-I FOUNDATION OF COGNITIVE COMPUTING 9

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services

Unit-II NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS 9

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations

Unit-III BIG DATA AND COGNITIVE COMPUTING 9

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics

Unit-IV BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING 9

Preparing for change ,advantages of new disruptive models , knowledge meaning to business, difference with a cognitive systems approach , meshing data together differently, using business knowledge to plan for the future , answering business questions in new ways , building business specific solutions , making cognitive computing a reality , cognitive application changing the market The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing

Unit-V APPLICATION OF COGNITIVE COMPUTING 9

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Judith H Hurwitz, Marcia Kaufman, Adrian Bowles	Cognitive computing and Big Data Analytics	Wiley	2015
2.	Noah D. Goodman, Joshua B. Tenenbaum	Probabilistic Models of Cognition	The ProbMods Contributors, Second Edition	2016

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23CSB20	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Objective:

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

Course Outcomes:

23CSB20.CO1	Understand basics of linguistics, probability and statistics associated with NLP.
23CSB20.CO2	Implement a Part-of-Speech Tagger.
23CSB20.CO3	Design and implement a sequence labeling problem for a given domain.
23CSB20.CO4	Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP.
23CSB20.CO5	Implement a simple chat bot using dialogue system concepts.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB20.CO1	X	X	X	X	-	-	-	X	-	X	-	X	X	-	-
23CSB20.CO2	-	-	X	X	X	-	X	-	X	-	X	-	-	X	X
23CSB20.CO3	X	X		-	-	-	X	-		X			-	X	-
23CSB20.CO4	X	-	X	-	-	X		X		-	-	X	X	X	-
23CSB20.CO5	X	X	-	X	-	X	X	-	X	-	X	-	-	-	X

Unit-I INTRODUCTION **9**

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

Unit-II STATISTICAL NLP AND SEQUENCE LABELING **9**

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

Unit-III CONTEXTUAL EMBEDDING **9**

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

Unit-IV COMPUTATIONAL SEMANTICS **9**

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

Unit-V DISCOURSE ANALYSIS AND SPEECH PROCESSING **9**

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

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Daniel Jurafsky and James H.Martin	Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition	Prentice Hall Series in Artificial Intelligence	2009
2.	Jacob Eisenstein	Natural Language Processing	MIT Press	2019
3.	Christopher Manning	Foundations of Statistical Natural Language Processing	MIT Press	2009
4.	Deepti Chopra, Nisheeth Joshi	Mastering Natural Language Processing with Python	Packt Publishing Limited	2016
5.	Mohamed Zakaria Kurdi	Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax (Cognitive Science)	ISTE Ltd	2016
6.	Atefeh Farzindar,Diana Inkpen	Natural Language Processing for Social Media(Synthesis Lectures on Human Language Technologies)	Morgan and Claypool Life Sciences	2015

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23CSB21	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the optimization techniques used in compiler design
- To be aware of the various computer architectures that support parallelism
- To become familiar with the theoretical background needed for code optimization
- To understand the techniques used for identifying parallelism in a sequential
- program
- To learn the various optimization algorithms

Course Outcomes:

23CSB21.CO1	Design and implement techniques used for optimization by a compiler.
23CSB21.CO2	Modify the existing architecture that supports parallelism.
23CSB21.CO3	Modify the existing data structures of an open source optimising compiler.
23CSB21.CO4	Design and implement new data structures and algorithms for code optimization.
23CSB21.CO5	Critically analyze different data structures and algorithms used in the building of an optimising compiler.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB21.CO1	X	X	X	X	-	-	-	X	-	X	-	X	X	-	-
23CSB21.CO2	-	-	X	X	X	-	X	-	X	-	X	-	-	X	X
23CSB21.CO3	X	X		-	-	-	X	-		X			-	X	-
23CSB21.CO4	X	-	X	-	-	X		X		-	-	X	X	X	-
23CSB21.CO5	X	X	-	X	-	X	X	-	X	-	X	-	-	-	X

Unit-I INTRODUCTION 9

Language Processors - The Structure of a Compiler – The Evolution of Programming Languages-The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator -Parser Generator - Overview of Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Principle Sources of Optimization.

Unit-II INSTRUCTION-LEVEL PARALLELISM 9

Processor Architectures – Code-Scheduling Constraints – Basic-Block Scheduling –Global Code Scheduling – Advanced code motion techniques – Interaction with Dynamic Schedulers- Software Pipelining

Unit-III OPTIMISING FOR PARALLELISM AND LOCALITY-THEORY 9

Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse- Array data dependence Analysis

Unit-IV OPTIMISING FOR PARALLELISM AND LOCALITY – APPLICATION 9

Finding Synchronisation - Free Parallelism – Synchronisation Between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms

Unit-V INTERPROCEDURAL ANALYSIS 9

Basic Concepts – Need for Interprocedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Interprocedural Analysis - Context- Sensitive Pointer-Analysis - Datalog Implementation by Binary Decision Diagrams.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman	Compilers: Principles, Techniques and Tools	Second Edition, Pearson Education	2008
2.	Randy Allen, Ken Kennedy	Optimizing Compilers for Modern Architectures: A dependence-based Approach	Morgan Kaufmann Publishers	2002
3.	Steven S. Muchnick	Advanced Compiler Design and Implementation	Morgan Kaufmann Publishers – Elsevier Science, India	2007
4.	John Hopcroft, Rajeev Motwani, Jeffrey Ullman	Introduction To Automata Theory Languages, and Computation	Third Edition, Pearson Education	2007
5.	Torbengidius Mogensen	Basics of Compiler Design	Springer	2011
6.	Charles N, Ron K Cytron, Richard J LeBlanc Jr	Crafting a Compiler	Pearson Education	2010

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23CSB22	DATA VISUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objective:

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

Course Outcomes:

23CSB22.CO1	Visualize the objects in different dimensions.
23CSB22.CO2	Design and process the data for Visualization.
23CSB22.CO3	Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.
23CSB22.CO4	Apply the virtualization techniques for research projects.
23CSB22.CO5	Identify appropriate data visualization techniques given particular requirements imposed by the data.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSB22.CO1	X	X	X	X	-	-	-	X	-	X	-	X	X	-	-
23CSB22.CO2	-	-	X	X	X	-	X	-	X	-	X	-	-	X	X
23CSB22.CO3	X	X		-	-	-	X	-		X			-	X	-
23CSB22.CO4	X	-	X	-	-	X		X		-	-	X	X	X	-
23CSB22.CO5	X	X	-	X	-	X	X	-	X	-	X	-	-	-	X

Unit-I INTRODUCTION AND DATA FOUNDATION 9

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

Unit-II FOUNDATIONS FOR VISUALIZATION 9

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

Unit-III VISUALIZATION TECHNIQUES 9

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

Unit-IV INTERACTION CONCEPTS AND TECHNIQUES 9

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

Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control

Unit-V RESEARCH DIRECTIONS IN VISUALIZATIONS 9

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

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Matthew Ward, Georges Grinstein and Daniel Keim	Interactive Data Visualization Foundations, Techniques, Applications	CRC Press	2010
2.	Colin Ware	Information Visualization Perception for Design	4th edition, Morgan Kaufmann Publishers	2021
3.	Robert Spence	Information visualization – Design for interaction	Pearson Education, 2nd Edition	2007
4.	Alexandru C. Telea	Data Visualization: Principles and Practice	A. K. Peters Ltd	2008

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23CSC01	ADVANCED ALGORITHMS	L	T	P	C
		3	0	0	3

Course Objectives

- Introduce students to the advanced methods of designing and analyzing algorithms
- The student should be able to choose appropriate algorithms and use it for a specific problem
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems
- Students should be able to understand different classes of problems concerning their computation difficulties
- To introduce the students to recent developments in the area of algorithmic design

Course Outcomes

23CSC01.C01 Analyze the complexity/performance of different algorithms.

23CSC01.CO2 Determine the appropriate data structure for solving a particular set of problems.

23CSC01.CO3 Categorize the different problems in various classes according to their complexity.

23CSC01.CO4 Students should have an insight of recent activities in the field of the advanced data structure.

23CSC01.CO5 Evaluate the linear programming of different algorithms.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC01.CO1	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
23CSC01.CO2	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
23CSC01.CO3	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-
23CSC01.CO4	-	X	X	X	-	-	-	-	X	-	X	-	X	-	-
23CSC01.CO5	-	X	X	X	-	-	-	-	X	-	X	-	X	-	-

UNIT I SORTING AND GRAPHING **9**

Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkastra's), depth-first search and computation of strongly connected components, Emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT II MATROIDS AND GRAPH MATCHING **9**

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

UNIT III FLOW-NETWORKS AND MATRIX COMPUTATIONS **9**

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond- Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT IV GRAPHS, POLYNOMIALS AND DISCRETE FOURIER TRANSFORM **9**

Shortest Path in Graphs: Floyd-Warshall algorithm and dynamic programming paradigm. More Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem, Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

UNIT V LINEAR PROGRAMMING 9

Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness-Approximation algorithms - Randomized Algorithms.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Cormen, Leiserson,Rivest, Stein	Introduction to Algorithms	MIT Press, 3rd Edition,	2009
2	Aho, Hopcroft, Ullman	The Design and Analysis of Computer Algorithms	Addison-Wesley Longman	1985
3	EthemAlpaydin	Introduction to Machine Learning	Data *Kleinberg*, Jon	2005
4	Hari Mohan Pandy	Design analysis and Algorithms	University SciencePress	2009
5	Kleinberg and Tardos	Algorithm Design	Pearson	2006

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23CSC02	ADVANCED ALGORITHMS LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

- To understand the concept of sorting and searching algorithms
- Analyze various algorithm to find minimum spanning tree
- To Study the Euclidean algorithm
- To implement modular exponentiation techniques
- To apply matrix for various algorithms

Course Outcomes

23CSC02.CO1 Understand the concept of sorting and searching algorithms.

23CSC02.CO2 Implement Prim's algorithm to find minimum spanning tree.

23CSC02.CO3 Apply Dijkstra's algorithm to find shortest path.

23CSC02.CO4 Implement warshall's algorithm to find all pair shortest path.

23CSC02.CO5 Perform matrix calculation for various applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC02.CO1	X	X	X	-	X	-	-	-	-	-	X	-	X	-	-
23CSC02.CO2	-	X	X	-	X	-	-	-	-	-	X	-	X	-	-
23CSC02.CO3	-	X	X	-	X	-	-	-	-	-	X	-	-	X	-
23CSC02.CO4	-	X	X	-	X	-	-	-	-	-	X	-	-	X	-
23CSC02.CO5	-	X	X	-	X	-	-	-	-	-	X	-	-	-	-

Sl.No. List of Experiments

1. Write a menu based program for sorting algorithms.
2. Write a menu based program for searching algorithms.
3. Write a menu driven program to perform DFS and BFS.
4. Implementation of Prim's algorithm to find minimum cost spanning tree
5. Implementation of Dijkstra's algorithm.
6. Implementation of Warshall's Algorithm.
7. Implementation of the extended Euclidean algorithm.
8. Implementation of the Modular exponentiation technique on an input data set.
9. Implementation of matrix multiplication Algorithm.
10. Implementation of Matrix Chain Multiplication.

Total Periods: 30

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23CSC03	WEB DATA MINING	L	T	P	C
		3	0	0	3

Course Objectives

- Introduces basic concepts, tasks, methods, and techniques in web mining
- Develop an understanding of the web mining process and issues, learn various techniques for data mining
- Learn the techniques in solving data mining problems using tools
- Understand classification and prediction algorithms for web data mining
- Apply the techniques in solving data mining problems using data mining tools and systems

Course Outcomes

23CSC03.CO1 Gain the knowledge of basic concepts data mining and its functionalities.

23CSC03.CO2 Familiar with data mining and knowledge discovery process.

23CSC03.CO3 Learn various techniques for web usage mining process and techniques.

23CSC03.CO4 Learn classification and prediction algorithms for web data mining.

23CSC03.CO5 Apply the techniques in solving data mining problems using data mining tools and systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC03.CO1	X	X	X	-	-	-	-	-	-	-	-	X	X	-	-
23CSC03.CO2	X	X	X	-	X	-	-	-	-	-	X	-	-	X	-
23CSC03.CO3	X	X	-	-	-	-	-	-	X	-	X	-	X	-	-
23CSC03.CO4	X	X	-	-	X	-	-	-	-	X	-	X	-	X	-
23CSC03.CO5	X	X	-	-	X	-	-	-	X	-	-	-	-	-	X

UNIT I INTRODUCTION **9**

What is Data Mining - Relational Databases - Data Warehouses - Transactional Databases - Advanced Database Systems - Data Mining Functionalities - Interestingness of a pattern Classification of Data Mining Systems - Major issues in Data Mining.

UNIT II DATA MINING AND KNOWLEDGE DISCOVERY **9**

The KDD process and methodology - Data preparation for knowledge discovery - Overview of data mining techniques - Market basket analysis - Classification and prediction – Clustering - Memory-based reasoning - Evaluation and Interpretation.

UNIT III WEB USAGE MINING PROCESS AND TECHNIQUES **9**

Data collection and sources of data- Data preparation for usage mining - Mining navigational patterns - Integrating e-commerce data - Leveraging site content and structure - User tracking and profiling - E- Metrics: measuring success in e-commerce Privacy issues.

UNIT IV CLASSIFICATION AND PREDICTION **9**

Concepts and Issues regarding Classification and Prediction – Classification by Decision Tree Induction – Bayesian Classification - Classification by Back-propagation - Classification Based on Concepts from Association Rule Mining.

UNIT V WEB MINING APPLICATIONS AND OTHER TOPICS **9**

Data integration for e-commerce - Web personalization and recommender systems - Web content and structure mining - Web data warehousing - Review of tools, applications, and systems.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Michael Berry and GordonLinoff, John Wiley	Data Mining Techniques for Marketing, Sales, and Customer Relationship Management	Second Edition	2004
2.	Ralph Kimball and RichardMerz,	The Data Web house Toolkit	John Wiley	2000
3.	RajkumarBuyya,	Mining the Web: Transforming Customer Data into Customer Value	Tata McGrawHill Edition	2013
4.	Gordon Linoff and MichaelBerry	Hadoop: The Definitive Guide	John Wiley &Sons	2001

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23CSC04	WEB ANALYTICS AND DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives

- The course explores use of social network analysis
- To understand growing connectivity and complexity in the world ranging from small groups to WWW
- Apply various web search Techniques in Real time problems
- Analyze the Random Graphs and Network evolution
- Implement the Robustness Social involvements

Course Outcomes

23CSC04.CO1 Gain the knowledge of Social network and Web data.

23CSC04.CO2 Familiar with web analytics tools and development.

23CSC04.CO3 Illustrate Web Search and Retrieval techniques.

23CSC04.CO4 Identify the Affiliation and identity of social connects.

23CSC04.CO5 Aware the robustness in social involvements and diffusion of innovation.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC04.CO1	X	X	X	-	-	-	-	-	X	-	-	-	X	-	-
23CSC04.CO2	X	X	X	-	X	-	-	-	-	-	X	-	-	X	-
23CSC04.CO3	X	X	-	-	X	-	-	-	-	-	X	-	X	-	-
23CSC04.CO4	X	X	-	X	-	-	X	-	-	-	-	X	-	X	-
23CSC04.CO5	X	X	-	-	X	-	-	-	X	-	-	-	-	-	X

UNIT I INTRODUCTION **9**

Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization .

UNIT II WEB ANALYTICS TOOLS **9**

Click Stream Analysis, A/B testing, Online Surveys.

UNIT III WEB SEARCH AND RETRIEVAL **9**

Click Stream Analysis, A/B testing, Online Surveys.

UNIT IV MAKING CONNECTION **9**

Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity.

UNIT V CONNECTION **9**

Connection Search, Collapse, Robustness Social involvements and diffusion of innovation.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hansen, Derek, Ben Sheiderman, Marc Smith	Data Mining Techniques for Marketing, Sales, and Customer Relationship Management	Second Edition	2004
2.	Avinash Kaushik	The Data Web house Toolkit	John Wiley	2000
3.	Easley, D. & Kleinberg, J.	Mining the Web: Transforming Customer Data into Customer Value	Tata McGrawHill Edition	2013
4.	Wasserman, S. & Faust, K.	Hadoop: The Definitive Guide	John Wiley & Sons	2001
5.	P. R. & Contractor,N. S.	Theories of communication networks	New York: Oxford University Press.	2003

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23CSC05	DATA STORAGE TECHNOLOGIES AND NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives

- To provide learners with a basic understanding of Enterprise Data Storage and Management Technologies
- To explain the design of a data center and storage requirements
- To discuss the various types of storage and their properties
- To explain physical and virtualization of storage
- To explain the backup, archiving with regard to recovery and business continuity

Course Outcomes

23CSC05.CO1 Learn Storage System Architecture.

23CSC05.CO2 Overview of Virtualization Technologies, Storage Area Network.

23CSC05.CO3 Analyze different aspects of data storage.

23CSC05.CO4 Apply many transformations in terms of techniques and hardware used for the same.

23CSC05.CO5 Describe Storage Area Networks And Storage QOS.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC05.CO1	-	X	-	-	X	-	-	-	-	-	-	X	-	X	-
23CSC05.CO2		-	X	X	-	X	-	X	-	-	X	-	-	-	X
23CSC05.CO3	X	-	-	-	-	-	X	-	-	-	X	-	X	-	X
23CSC05.CO4		X		X	-	-	-	-	-	-	-	X		-	-
23CSC05.CO5	X	X	X	-	-	-	-	-	X	X	-	-	X	-	-

UNIT I STORAGE MEDIA AND TECHNOLOGIES 9

Storage Media and Technologies -Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations

UNIT II WEB ANALYTICS TOOLS 9

Usage and Access -Positioning in the Memory Hierarchy, Hardware and Software Design for Access,Performance issues.

UNIT III WEB SEARCH AND RETRIEVAL 9

Large Storages -Hard Disks, Networked Attached Storage, Scalability issues, Networking issues.

UNIT IV MAKING CONNECTION 9

Storage Architecture - Storage Partitioning, Storage System Design, Caching, Legacy Systems.

UNIT V CONNECTION 9

Connection Search, Collapse, Robustness Social involvements and diffusion of innovation. Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids. Storage QoS – Performance, Reliability, and Security issues.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Franklyn E. Dailey	Data Mining Techniques for Marketing, Sales, and Customer Relationship Management	Second Edition	2004
2.	Nigel Poulton	Data Storage Networking : RealWorld Skills for the CompTIA Storage	Sybex	2014

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23CSC06	PATTERN CLASSIFICATION AND ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives

- To Study the fundamental algorithms for pattern recognition
- To instigate the various Pattern classification techniques
- To originate the various structural pattern recognition and feature extraction techniques
- To understand the clustering concepts
- To learn the recent advances in neural networks

Course Outcomes

23CSC06.CO1 Understand and apply various algorithms for pattern recognition.

23CSC06.CO2 Realize the clustering concepts and algorithms.

23CSC06.CO3 Bring out feature extraction techniques.

23CSC06.CO4 Easily understand the concept of fundamental algorithms for pattern recognition.

23CSC06.CO5 Analyze the recent advances in neural networks.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC06.CO1	X	X	X	X	-	-	-	-	-	-	-	-	X	-	X
23CSC06.CO2	X	X	X	X	-	-	-	-	-	-	X	-	-	X	-
23CSC06.CO3	X	X	X	-	-	-	-	-	-	-	X	-	X	-	-
23CSC06.CO4	X	X	X	X	X	-	-	-	-	-	-	X	-	-	X
23CSC06.CO5	X	X	X	-	-	-	-	-	-	-	-	X	X	-	-

UNIT I PATTERN CLASSIFIER **9**

Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation Maximum likelihood estimation - Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm - Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier

UNIT II UNSUPERVISED CLASSIFICATION **9**

Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm – Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT III STRUCTURAL PATTERN RECOGNITION **9**

Elements of formal grammars - String generation as pattern description - Recognition of syntactic description -Parsing - Stochastic grammars and applications - Graph based structural representation.

UNIT IV FEATURE EXTRACTION AND SELECTION **9**

Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation -Binary feature selection.

UNIT V RECENT ADVANCES **9**

Neural network structures for pattern recognition - Neural network based pattern associators – Unsupervised learning in neural pattern recognition - Self organizing networks - Fuzzy logic - Fuzzy pattern classifiers – Pattern classification using Genetic Algorithms. STATE OF ART (Not for Exam) Image Transforms: DFT, DCT, Haar,SVD and KL- Introduction to Matlab Toolbox.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Robert J.Schalkoff, Pattern Recognition	Statistical, Structural and Neural	John Wiley &Sons Inc., New York	2007
2	Tou and Gonzales	Pattern Recognition Principles	Wesley Publication Company, London	2008
3	Duda R.O., and Hart.P.E	Pattern Classification and Scene Analysis	Wiley, New York	2009
4	Morton Nadier and Eric Smith P	Pattern Recognition Engineering Shape analysis and	John Wiley & Sons, New York	2009
5	LFD Costa, RM Cesar Jr	classification: theory and practice	ACM Digital Library	2011

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23CSC07	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives

- To learn the basic architecture and concepts till Third Generation Communication systems
- To understand the latest 4G Telecommunication System Principles
- To introduce the broad perspective of pervasive concepts and management
- To explore the HCI concepts in Pervasive environment
- To apply the pervasive concepts in mobile environment

Course Outcomes

23CSC07.CO1	Obtain a thorough understanding of basic architecture and concepts of till Third Generation Communication systems.
23CSC07.CO2	Explain the latest 4G Telecommunication System Principles.
23CSC07.CO3	Incorporate the pervasive concepts.
23CSC07.CO4	Implement the HCI in Pervasive environment.
23CSC07.CO5	Work on the pervasive concepts in mobile environment.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC07.CO1	X	-	X	X	-	-	-	-	X	-	-	-	X	-	-
23CSC07.CO2	-	-	X	X	-	-	-	-	-	-	X	X	-	X	-
23CSC07.CO3	-	X	-	X	-	-	X	-	-	-	-	-	X	-	X
23CSC07.CO4	X	X	-	-	X	-	-	-	-	-	X	-	-	X	-
23CSC07.CO5	X	-	X	-	-	-	X	-	-	-	-	-	X	-	X

UNIT I INTRODUCTION **9**

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT II DATA MINING AND KNOWLEDGE DISCOVERY **9**

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC- FDMA. Summary of OFDMA.

UNIT III WEB USAGE MINING PROCESS AND TECHNIQUES **9**

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management -Service Management - Data Management - Security Management - Pervasive Computing Environments - Smart Car Space - Intelligent Campus .

UNIT IV CLASSIFICATION AND PREDICTION **9**

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context-Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm.

UNIT V WEB MINING APPLICATIONS AND OTHER TOPICS 9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Michael Berry and Gordon Linoff, John Wiley	Data Mining Techniques for Marketing, Sales, and Customer Relationship Management	Second Edition	2004
2.	Ralph Kimball and RichardMerz,	The Data Web house Toolkit	John Wiley	2000
3.	RajkumarBuyya,	Mining the Web: Transforming Customer Data into Customer Value	Tata McGrawHill Edition	2013
4.	Gordon Linoff and MichaelBerry	Hadoop: The Definitive Guide	John Wiley & Sons	2001

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23CSC08	AD HOC AND WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives

- To learn the basics of sensor networks
- To impart knowledge on the design and development of the data link and network layers in the WSN protocol stack
- To understand the working of protocols in different layers of sensor networks
- To learn the establishment of wireless sensor networks
- To familiarize the students with the hardware and software platforms used in the design of WSN

Course Outcomes

23CSC08.CO1	Ability to learn the basics of sensor networks.
23CSC08.CO2	To impart knowledge on the design and development of the data link and network layers in the WSN protocol stack.
23CSC08.CO3	Analyze the working of protocols in different layers of sensor networks.
23CSC08.CO4	To learn the establishment of wireless sensor networks.
23CSC08.CO5	Analyze to understand the hardware

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC08.CO1	X	-	X	-	-	X	-	X	X	-	X	-	-	X	-
23CSC08.CO2	-	-	X	X	-	-	-	-		-	X	-	X	X	X
23CSC08.CO3	X	X	-	-	X	-	X	-	X	X	-	-	-	X	-
23CSC08.CO4	X	X	-	X	-	-		-	X	-	X	X	X	X	X
23CSC08.CO5	X	-	X	-	-	X	-	X	-	X	-	X	-	-	X

UNIT I AD-HOC MAC **9**

Introduction - Issues in Ad-Hoc Wireless Networks. MAC Protocols - Issues, Classifications of MAC protocols, Multi channel MAC & Power control MAC protocol.

UNIT II AD-HOC NETWORK ROUTING & TCP **9**

Issues - Classifications of routing protocols - Hierarchical and Power aware. Multicast routing - Classifications, Tree based, Mesh based. Ad Hoc Transport Layer Issues. TCP Over Ad Hoc - Feedback based, TCP with explicit link, TCP-BuS, Ad Hoc TCP, and Split TCP.

UNIT III WSN –MAC **9**

Introduction - Sensor Network Architecture, Data dissemination, Gathering. MAC Protocols - self-organizing, Hybrid TDMA/FDMA and CSMA based MAC.

UNIT IV WSN ROUTING, LOCALIZATION & QOS **9**

Issues in WSN routing - OLSR, AODV. Localization - Indoor and Sensor Network Localization. QoS in WSN.

UNIT V WEB MINING APPLICATIONS AND OTHER TOPICS **9**

Necessity for Mesh Networks - MAC enhancements- IEEE802.11s Architecture- Opportunistic routing –

Self configuration and Auto configuration - Capacity Models - Fairness - Heterogeneous Mesh Networks - Vehicular Mesh Networks.

Total Periods: 45

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23CSC09	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Objective:

- To get acquainted with the building blocks of Internet of Things (IoTs), characteristics and taxonomy of IoT levels
- To learn a generic design methodology
- To learn a programming aspects of IoT
- To know about various packages, frameworks and cloud services
- To get acquainted with data analytics for IoT

Course Outcomes:

23CSC09.CO1 Identify and design the new models for market strategic interaction.

23CSC09.CO2 Design business intelligence and information security for WoB.

23CSC09.CO3 Analyze various protocols for IoT.

23CSC09.CO4 Analyze programming aspects of IoT.

23CSC09.CO5 To know about various packages, frameworks and cloud services.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC09.CO1	X	-	X	-	X	-	-	X	-	X	-	X	X	X	-
23CSC09.CO2	X	X	-	-	X	-	-	X	X	X	-	-	X	-	-
23CSC09.CO3	X	X	X	X	-	X	-	-	X	X	X	X	-	X	-
23CSC09.CO4	X	X	X	X	-	X	-	-	X	X	X	-	X	-	X
23CSC09.CO5	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-

UNIT-I INTRODUCTION TO IOT **9**

Definition and Characteristics – Physical Design Things – Protocols - Logical Design – Functional Blocks – Communication Models – Communication APIs – Introduction to measure the physical quantities – IoT Enabling Technologies – Wireless Sensor Networks - Cloud Computing – Big Data Analytics – CommunicationProtocols – Embedded Systems – IoT Levels and Deployment Templates.

UNIT-II DEVELOPING INTERNET OF THINGS **9**

Introduction to Smart Systems using IoT – IoT Design Methodology – Case Study: Weather Monitoring – Logical Design using Python – Data types & Data Structures – Control Flow – Functions – Modules – Packages– File Handling – Date/Time Operations – Classes – Python Packages of Interest for IoT.

UNIT-III DOMAIN SPECIFIC IoTs **9**

Home Automation – Cities – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health and Lifestyle – IoT and M2M.

UNIT-IV IoT PHYSICAL DEVICES, ENDPOINTS AND CLOUD OFFERINGS **9**

IoT Device – Raspberry Pi – Interfaces – Programming Raspberry Pi with Python – Other IoT Devices – IoT Physical Servers and Cloud Offerings – Cloud Storage Models and communication APIs – WAMP – Xively Cloud – Django – Amazon Web Services for IoT – SkyNet IoT Messaging Platform – Basics of Secure IoT Programming – Case Study: Home Automation.

UNIT-V DATA ANLYTICS FOR IoT **9**

Data integration for e-commerce - Web personalization and recommender systems - Web content and structure mining - Web data warehousing - Review of tools, applications, and systems.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Arshadeep Bahga,Vijay Madisetti	Internet of Things: A Hands-On Approach	Published by Arshdeep Bahga & Vijay Madisetti	2014
2.	Mike Kuniavsky	Smart Things: UbiquitousComputing User ExperienceDesign	Morgan Kaufmann Publishers	2010
3.	Wimer Hazenberg	Meta Products: Building the Internet of Things. Sara Cordoba	Menno Huisman BIS Publishers	2011
4.	Massimo Banzi	Getting Started with Arduino(Make: Projects)	O'Reilly Media	2008
5.	Barnaghi	Semantics for the Internet of things	Addison Wesley	2012

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23CSC10	INTERNET OF THINGS LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To study the assembly language using simulator and kit
- To implement ALU operations
- To generate waveforms and test timers
- To develop applications using Embedded C language
- To design IoT applications using Arduino, Raspberry Pi, and Bluemix

Course Outcomes:

23CSC10.CO1 Execute Assembly Language experiments using simulator.

23CSC10.CO2 Implement ALU operations.

23CSC10.CO3 Design waveforms and test timers.

23CSC10.CO4 Develop real time applications and explore ARM/PIC using Embedded C.

23CSC10.CO5 Demonstrate real time applications using Arduino, Raspberry Pi, and Bluemix.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC10.CO1	X	-	X	X	-	-	X	-	-	X	-	X	X	X	-
23CSC10.CO2	X	X	-	-	X	-	X	X	X	X	-	-	X	-	-
23CSC10.CO3	X	X	X	X	-	X	-	-	X	X	X	X	X	-	-
23CSC10.CO4	X	X	X	-	X	X	-	X	X	X	X	-	-	-	X
23CSC10.CO5	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-

Sl.No.	List of Experiments
1	Write Basic and arithmetic Programs Using Embedded C.
2	Write Embedded C program to test interrupt and timers.
3	Develop Real time applications – clock generation, wave form generation, counter using embedded C.
4	Explore ARM/PIC based controllers using Embedded C.
5	Explore different communication methods with IoT devices
6	Develop simple application – testing infrared sensor – IoT Applications – using Arduino.
7	Develop simple application – testing temperature, light sensor – IOT Application using open Platform /Raspberry Pi.
8	Deploy IOT applications using platforms such as Bluemix.

Total Periods: 30

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23CSC11	DATA PREPARATION AND ANALYSIS	L	T	P	C
		3	0	0	3

Course Objective:

- To prepare the data for analysis
- To develop meaningful Data
- Learn the different ways of Data Analysis
- Be familiar with data streams
- Be familiar with the visualization

Course Outcomes:

23CSC11.CO1 Work in a business environment in which data preparation occurs.

23CSC11.CO2 Apply data cleaning techniques on real world data and prepare data for analysis.

23CSC11.CO3 Perform exploratory analysis on data, such as calculating descriptive and comparative Statistics.

23CSC11.CO4 Experiment visualization techniques for various data analysis tasks.

23CSC11.CO5 Illustrate Clustering and association techniques.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC11.CO1	X	-	-	X	-	-	X	-	-	-	X	-	X	-	-
23CSC11.CO1	-	-	X	X	X	-	-	-	-	-	-	X	-	X	-
23CSC11.CO1	-	X	-	-	-	-	-	-	-	-	X	X	X	-	X
23CSC11.CO1	X	X	-	-	X	-	-	-	-	X	-	-	-	X	-
23CSC11.CO5	X	-	X	-	-	X	-	-	-	-	X	-	X	-	-

UNIT-I DATA GATHERING AND PREPARATION 9

Defining Data analysis problems: Knowing the client-understanding the questions- Data Gathering and Preparation: Data formats-parsing and transformation-Scalability and real-time issues

UNIT-II DATA CLEANING 9

Data Cleaning: Consistency checking-Heterogeneous and missing data- Data Transformation andsegmentation.

UNIT-III EXPLORATORY ANALYSIS 9

Exploratory Analysis: Descriptive and comparative statistics- Clustering and association-HypothesisGeneration

UNIT-IV VISUALIZATION 9

Visualization: Designing visualizations- Time series-Geolocated data- Correlations and connections-Hierarchies and networks- interactivity.

UNIT-V STATISTICS 9

Descriptive statistics-Inferential statistics-Comparative statistics

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	GlennJ. Myatt	Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining	John Wiley & Sons, Inc Second edition	2014
2.	Michael Berthold,David J. Hand	Intelligent Data Analysis	Springer	2007
3.	Donald J. Wheeler	Making Sense of Data	SPC Press	2003
4.	Dorian Pyle	Data Preparation for Data Mining	Morgan Kaufmann	1999
5.	Gerhard Svolba	Data Preparation for Analytics Using SAS	SAS Institute	2006

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23CSC12	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objective:

- To analyze various performance related parameters in computer architecture and understand instruction set architectures
- To understand Instruction Level Parallelism(ILP) with its limitations
- To utilize the ILP concept for memory design
- To review various issues in multiprocessor
- To understand the design of the memory hierarchy and analyze the types of multiprocessors

Course Outcomes:

23CSC12.CO1	Understand performance related parameters and the concepts of Instruction Set Architectures.
23CSC12.CO2	Describe Instruction Level parallelism and identify the limitations of ILP.
23CSC12.CO3	Discuss the approaches of exposing and exploiting ILP.
23CSC12.CO4	Design hierarchical memory System.
23CSC12.CO5	Analyze the types of multiprocessor architecture and storage devices.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC12.CO1	X	-	X	-	X	-	-	-	X	-	-	-	X	-	-
23CSC12.CO2	X	X	-	-	-	X	X	-	-	-	-	-	-	X	-
23CSC12.CO3	-	-	X	-	X	-	-	X	-	X	-	-	X	-	-
23CSC12.CO4	-	-	X	X	-	-	-	-	-	-	X	X	-	X	-
23CSC12.CO5	-	X	X	-	X	-	-	-	X	-	-	-	-	-	X

UNIT-I FUNDAMENTALS OF COMPUTER DESIGN **9**

Introduction-measuring and reporting performance- Quantitative principles of computer design- Instructionset principles and examples- classifying instructions- set architectures-memory addressing- addressingmodes for signal processing-type and size of operands.

UNIT-II INSTRUCTION LEVEL PARALLELISM **9**

Concepts and challenges – overcoming data hazards with dynamic scheduling – examples- reducing branch costs with dynamic hardware prediction- high performance instruction delivery- taking advantages of ILP with multiple issues-limitations of ILP.

UNIT-III ILP WITH SOFTWARE APPROACHES **9**

Basic compiler techniques for exposing ILP- static branch prediction- static multiple issues: VLIW approach-Advanced compiler support for exposing and exploiting ILP-Hardware support-cross cutting issues- Intel IA64 architecture.

UNIT-IV MEMORY HIERARCHY DESIGN **9**

Introduction- review of caches- cache performance- reducing cache miss penalty-reducing miss rate-missrate via parallelism –reducing hit time – main memory and organizations for improving performance-memory technology- virtual memory.

UNIT-V MULTIPROCESSORS AND THREAD LEVEL PARALLELISM 9

Symmetric shared memory architectures-performance of symmetric shared memory multiprocessors – Distributed shared memory architectures-synchronization- storage systems – types of storage devices- buses-reliability-availability and dependability- RAID – errors and failures in real systems- I/O performance measures-Introduction to queuing theory.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	John L. Hennessy and David A. Patterson	Computer Architecture: AQuantitative Approach	Morgan Kaufmann,3rd Edition	2003
2	Sima D. FountainT. And Kacsuk P	Advanced Computer Architectures: A Design Space Approach	Addison Wesley	2000
3	Kai Hwang	Advanced Computer Architecture: Parallelism, Scalability, Programmability	Tata McGraw HillEdition	2001

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23CSC13	MULTICORE ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the recent trends in the field of Computer Architecture and identify performance related parameters
- To appreciate the need for parallel processing
- To expose the students to the problems related to multiprocessing
- To understand the different types of multicore architectures
- To expose the students to warehouse-scale and embedded architectures

Course Outcomes:

23CSC13.CO1	Identify the limitations of ILP and the need for multicore architectures.
23CSC13.CO2	Point out the salient features of different multicore architectures and how they exploit parallelism.
23CSC13.CO3	Expose the different multiprocessor issues.
23CSC13.CO4	Discuss the warehouse-scale computers architectures.
23CSC13.CO5	Build the Requirements of Embedded Systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC13.CO1	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-
23CSC13.CO2	X	-	X	X	-	-	-	X	-	-	X	-	-	X	-
23CSC13.CO3	X	X	X	-	-	-	X	-	-	-	X	-	X	-	X
23CSC13.CO4	X	X	X	-	X	-	-	-	-	-	-	X	-	X	-
23CSC13.CO5	X	X	X	-	-	-	-	-	X	X	-	-	X	-	-

UNIT-I FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS 9

Classes of Computers – Trends in Technology, Power, Energy and Cost – Dependability – Measuring, Reporting and Summarizing Performance – Quantitative Principles of Computer Design – Classes of Parallelism - ILP, DLP, TLP and RLP.

UNIT-II DLP IN VECTOR, SIMD AND GPU ARCHITECTURES 9

Vector Architecture - SIMD Instruction Set Extensions for Multimedia – Graphics ProcessingUnits - Detecting and Enhancing Loop Level Parallelism.

UNIT-III TLP AND MULTIPROCESSORS 9

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

UNIT-IV WAREHOUSE-SCALE ARCHITECTURES 9

Programming Models and Workloads for Warehouse-Scale Computers – Architectures for Warehouse-Scale Computing – Physical Infrastructure and Costs – Cloud Computing – Case Studies.

UNIT-V ARCHITECTURES FOR EMBEDDED SYSTEMS **9**

Features and Requirements of Embedded Systems – Signal Processing and Embedded Applications – The Digital Signal Processor – Embedded Multiprocessors.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	John L. Hennessey and David A. Patterson	"Computer Architecture – A Quantitative Approach"	Morgan Kaufmann / Elsevier, 5th edition	2012
2	Darryl Gove	"Multicore Application Programming for Windows, Linux, and Oracle Solaris"	Pearson	2011
3	Richard Y. Kain,	"Advanced Computer Architecture a Systems Design Approach"	Prentice Hall	2011

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23CSC14	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the working of protocols in different layers of sensor networks
- To learn the establishment of wireless sensor networks
- To familiarize the students with the hardware and software platforms used in the design of WSN
- To learn the establishment of wireless sensor networks
- To Analysis of various critical parameters in deploying a WSN

Course Outcomes:

23CSC14.CO1	Ability to learn the basics of sensor networks.
23CSC14.CO2	To impart knowledge on the design and development of the data link and network layers in the WSN protocol stack.
23CSC14.CO3	Analyze the working of protocols in different layers of sensor networks.
23CSC14.CO4	Technical knowhow in building a WSN network.
23CSC14.CO5	Analyze to understand the hardware.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC14.CO1	-	X	X	-	X	-	-	-	-	-	-	X	-	X	-
23CSC14.CO2	-	-	X	X	-	X	-	X	-	-	X	-	-	X	-
23CSC14.CO3	X			-	-	-	X	-	-	-	X	-	X	-	X
23CSC14.CO4		X	X	X	-	-	-	-	-	-	-	-		-	-
23CSC14.CO5	X	X	X	-	-	-	-	-	X	X	-	-	X	-	-

Unit-I Introduction **9**

Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

Unit-II Wireless Sensor Networks **9**

Introduction - Sensor Network Architecture, Data dissemination, Gathering. MAC Protocols - self- organizing, Hybrid TDMA/FDMA and CSMA based MAC.

Unit-III WSN- Routing **9**

MAC Protocols : Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

Unit-IV QoS and Energy Management **9**

Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

Unit-V WSN Localization & QoS **9**

Issues in WSN routing - OLSR, AODV. Localization - Indoor and Sensor Network Localization. QoS in WSN.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Feng Zhao and Leonidas Guibas	Wireless Sensor Networks	Morgan Kaufman Publishers	2004
2	William Stallings	Wireless Communications and Networks	Pearson Education	2004
3	C.Siva Ram Murthy and B.Smanoj	Ad Hoc Wireless Networks -	Pearson Education	2004

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23CSC15	COMPUTER VISION	L	T	P	C
		3	0	0	3

Course Objective:

- To review image processing techniques for computer vision
- To understand shape and region analysis
- To understand Hough Transform and its applications to detect lines
- To understand motion analysis
- To study some applications of computer vision algorithms

Course Outcomes:

23CSC15.CO1 Implement fundamental image processing techniques required for computer vision.

23CSC15.CO2 Perform shape analysis.

23CSC15.CO3 Apply Hough Transform for line, circle, and ellipse detections.

23CSC15.CO4 Implement motion related techniques.

23CSC15.CO5 Develop applications using computer vision techniques.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC15.CO1	X	X	X	-	X	-	-	-	-	-	-	X	-	X	-
23CSC15.CO2	X	-	X	X	-	X	-	X	-	-	X	-	-	X	-
23CSC15.CO3	X	X	X	-	-	-	X	-	-	-	X	-	X	-	X
23CSC15.CO4	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-
23CSC15.CO5	X	X	X	-	-	-	-	-	X	X	-	-	X	-	-

Unit-I Image Processing Foundations **9**

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture

Unit-II Shapes and Regions **9**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

Unit-III Hough Transform **9**

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT).

Unit-IV 3D Vision and Motion **9**

from texture – shape from focus – active range finding – surface representations – point-based representation – Volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion- – layered motion.

Unit-V Applications **9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape

models faces - Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians- Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	D. L. Baggio et al	Mastering OpenCV with Practical Computer VisionProjects	Packt Publishing,	2012
2.	Mark Nixon and Alberto S. Aquado	Feature Extraction & Image Processing for Computer Vision	Third Edition, Academic Press	2012
3.	R. Szeliski	Computer Vision: Algorithms andApplications	Springer	2011

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23CSC16	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objective:

- Introduce the basics of Blockchain technology
- Explore various aspects of Blockchain technology like application in various domains
- Explain the private and public Blockchain, and smart contract
- Develop apps using Ethereum
- To develop an applications using Blockchain

Course Outcomes:

23CSC16.CO1 Understand and explore the working of Blockchain technology.

23CSC16.CO2 Analyze the working of Smart Contracts.

23CSC16.CO3 Understand and analyze the working of Hyperledger.

23CSC16.CO4 Apply the learning of solidity to build de-centralized apps on Ethereum.

23CSC16.CO5 Develop applications on Blockchain.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC16.CO1	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
23CSC16.CO2	X	X	-	-	-	-	-	-	X	-	X	-	X	-	-
23CSC16.CO3	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-
23CSC16.CO4	-	X	X	-	-	-	-	-	X	-	X	-	X	-	-
23CSC16.CO5	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-

Unit-I Introduction of Cryptography and Blockchain 9

Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

Unit-II Bitcoin and Cryptocurrency 9

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency

Unit-III Introduction to Ethereum 9

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

Unit-IV Introduction to Hyperledger and Solidity Programming 9

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

Unit-V Blockchain Applications 9

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Imran Bashir	Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained	Second Edition, Packt Publishing	2018
2.	Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder	Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction	Princeton University Press	2016
3.	Antonopoulos	Mastering Bitcoin	O'Reilly Publishing	2014
4.	Antonopoulos and G. Wood	Mastering Ethereum: Building Smart Contracts and Dapps	O'Reilly Publishing	2018
5.	D. Drescher	Blockchain Basics	Apress	2017

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23CSC17	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To learn about the principles of cyber-physical systems.
- To familiarize with the basic requirements of CPS.
- To explore the applications and platforms.
- To provide introduction to practical aspects of cyber physical systems.
- To implement CPS tools.

Course Outcomes:

23CSC17.CO1 Explain the core principles behind CPS.

23CSC17.CO2 Discuss the requirements of CPS.

23CSC17.CO3 Explain the various models of CPS.

23CSC17.CO4 Describe the foundations of CPS.

23CSC17.CO5 Use the various platforms to implement the CPS.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC17.CO1	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
23CSC17.CO2	X	X	-	-	-	-	-	-	X	-	X	-	X	-	-
23CSC17.CO3	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-
23CSC17.CO4	-	X	X	-	-	-	-	-	X	-	X	-	X	-	-
23CSC17.CO5	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-

Unit-I Introduction to Cyber-Physical Systems **9**

Cyber-Physical Systems(CPS)-Emergence of CPS, Key Features of Cyber-Physical Systems, CPS Drivers-Synchronous Model : Reactive Components, Properties of Components, Composing Components, Designs-Asynchronous Model of CPS: Processes, Design Primitives, Coordination Protocols.

Unit-II CPS - Requirements **9**

Safety Specifications: Specifications, Verifying Invariants, Enumerative Search, Symbolic Search-Liveness Requirements: Temporal Logic, Model Checking, Proving Liveness.

Unit-III CPS Models **9**

Dynamical Systems: Continuous, Linear Systems-Time Models, Linear Systems, Designing Controllers, Analysis Techniques- Timed Model: Processes, Protocols, Automata- Hybrid Dynamical Models.

Unit-IV CPS Foundations **9**

Symbolic Synthesis for CPS- Security in CPS-Synchronization of CPS-Real-Time Scheduling for CPS.

Unit-V Applications and Platforms **9**

Medical CPS- CPS Built on Wireless Sensor Networks- CyberSim User Interface- iClebo Kobuki - iRobot Create-myRIO- Cybersim- Matlab toolboxes - Simulink.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Raj Rajkumar, Dionisio De Niz , and Mark Klein	Cyber-Physical Systems	Addison-Wesley Professional	2016
2	Rajeev Alur	Principles of Cyber-Physical Systems	MIT Press	2015
3	Lee, Edward Ashford, and Sanjit Arunkumar Seshia	Introduction to embedded systems: A cyber physical systems approach	-	2017
4	Jean J. Labrosse	Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C	The publisher, Paul Temme	2011
5	Jensen, Jeff, Lee, Edward, A Seshia, Sanjit	An Introductory Lab in Embedded and Cyber-Physical Systems	-	2014

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23CSC18	FULL STACK WEB APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objective:

- Develop TypeScript Application
- Develop Single Page Application (SPA)
- Able to communicate with a server over the HTTP protocol
- Learning all the tools need to start building applications with Node.js
- Implement the Full Stack Development using MEAN Stack

Course Outcomes:

23CSC18.CO1 Develop basic programming skills using Javascript.

23CSC18.CO2 Implement a front-end web application using Angular.

23CSC18.CO3 Will be able to create modules to organise the server.

23CSC18.CO4 Build RESTful APIs with Node, Express and MongoDB with confidence.

23CSC18.CO5 Will learn to Store complex, relational data in MongoDB using Mongoose.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC18.CO1	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
23CSC18.CO2	X	X	-	-	-	-	-	-	X	-	X	-	X	-	-
23CSC18.CO3	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-
23CSC18.CO4	-	X	X	-	-	-	-	-	X	-	X	-	X	-	-
23CSC18.CO5	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-

Unit-I Fundamentals & Typescript Language **9**

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

Unit-II Angular **9**

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. HttpClient. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses

Unit-III NODE.js **9**

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and TypedArrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

Unit-IV Express.js **9**

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router.route(path). Router Class. Request Object. Response Object. Error Handling. RESTful.

Unit-V MongoDB **9**

Introduction to MongoDB. Documents. Collections. Subcollections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and CollectionTypes. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1	Adam Freeman	Essential TypeScript	Apress	2019
2	Mark Clow	Angular Projects	Apress	2018
3	Alex R. Young, Marc Harter	Node.js in Practice	Manning Publication	2014
4	Azat Mardan	Pro Express.js	Apress	2015
5	Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins	MongoDB in Action	Manning Publication, Second edition	2016

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23CSC19	FOG & EDGE COMPUTING	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the students about edge computing, an important branch of distributed computing and IoT with significant applications in Data Science
- To implement the concepts of fog and cloud computing and exposes students to modern tools and API to deploy relevant infrastructures
- Explore the real time applications of Fog
- To understand the concept of Edge computing
- To design the model of IoT and edge architecture

Course Outcomes:

23CSC19.CO1 Explore the need for new computing paradigms.

23CSC19.CO2 Explain the major components of fog and edge computing architectures.

23CSC19.CO3 Identify potential technical challenges of the transition process and suggest solutions.

23CSC19.CO4 Analyze data and application requirements and pertaining issues.

23CSC19.CO5 Design and model infrastructures.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC19.CO1	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
23CSC19.CO2	X	X	-	-	-	-	-	-	X	-	X	-	X	-	-
23CSC19.CO3	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-
23CSC19.CO4	-	X	X	-	-	-	-	-	X	-	X	-	X	-	-
23CSC19.CO5	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-

Unit-I Edge Computing **9**

Fog computing requirements when applied to IoT: Scalability, Interoperability, Fog-IoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virtualization, security and privacy issues. Integrating IoT, Fog, Cloud Infrastructures: Methodology , Integrated C2F2T Literature by Modelling Technique re by Use-Case Scenarios , Integrated C2F2T Literature by Metrics.

Unit-II Fog Computing in Health Monitoring **9**

Exploiting Fog Computing in Health Monitoring : An Architecture of a Health Monitoring IoT- Based System with Fog Computing , Fog Computing Services in Smart E-Health Gateways, Discussion of Connected Components. Fog Computing Model for Evolving Smart Transportation Applications: Introduction , Data-Driven Intelligent Transportation Systems , Fog Computing for Smart Transportation Applications Case Study: Intelligent Traffic Lights Management (ITLM) System.

Unit-III Fog Computing Application **9**

Software Defined Networking and application in Fog Computing: Open Flow Protocol, Open Flow Switch, SDN in Fog Computing, Home Network using SDN. Security and Privacy issues: Trust and privacy issues in IoT Network, web Semantics and trust Management for Fog Computing, Machine Learning based security in Fog Computing, Cyber- Physical Energy Systems over Fog Computing.

Unit-IV Introduction to Edge Computing **9**

Introduction to Edge Computing Scenarios and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog, and M2M.

Unit-V IoT Architecture and Core IoT Modules **9**

IoT Architecture and Core IoT Modules-A connected ecosystem, IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with the examples- Edge computing with RaspberryPi, Industrial, and Commercial IoT and Edge, and Edge computing and solutions.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Perry Lea	IoT and Edge Computing for Architects	Packt Publishing	2020
2.	Rajkumar Buyya and Satish Narayana Srirama	Fog and Edge Computing: Principles and Paradigms	Wiley Series	-

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23CSC20	GPU COMPUTING	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the basics of GPU architectures
- To understand CPU GPU Program Partitioning
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

Course Outcomes:

23CSC20.CO1	Describe GPU Architecture.
23CSC20.CO2	Write programs using CUDA, identify issues and debug them.
23CSC20.CO3	Implement efficient algorithms in GPUs for common application kernels, such as Matrix multiplication.
23CSC20.CO4	Write simple programs using OpenCL.
23CSC20.CO5	Create an Algorithms on GPU and evaluation.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSC20.CO1	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
23CSC20.CO2	X	X	-	-	-	-	-	-	X	-	X	-	X	-	-
23CSC20.CO3	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-
23CSC20.CO4	-	X	X	-	-	-	-	-	X	-	X	-	X	-	-
23CSC20.CO5	-	X	-	X	-	-	-	-	X	-	X	-	X	-	-

Unit-I GPU Architecture **9**

Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

Unit-II CUDA Programming **9**

Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

Unit-III Programming Issues **9**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

Unit-IV OpenCL Basics **9**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples

Unit-V Algorithms on GPU **9**

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication – Programming Heterogeneous Cluster.

Total Periods: 45

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Shane Cook	CUDA Programming: "A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)	First Edition, Morgan Kaufmann	2012
2.	David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang	Heterogeneous computing with OpenCL, 3rd Edition	Morgan Kauffman	2015
3.	Nicholas Wilt	CUDA Handbook: A Comprehensive Guide to GPU Programming	Addison - Wesley	2013
4.	Jason Sanders, Edward Kandrot	CUDA by Example: An Introduction to General Purpose GPU Programming	Addison - Wesley	2010
5.	David B. Kirk, Wen-mei W. Hwu	Programming Massively Parallel Processors - A Hands-on Approach, Third Edition	Morgan Kaufmann	2016

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23CSD04	VALUE EDUCATION	L	T	P	C
		2	0	0	2

Course Objective:

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character
- To teach and inculcate the importance of value based living
- To give students a deeper understanding about the purpose of life

Course Outcomes:

23CSD04.CO1 Knowledge of self-development.

23CSD04.CO2 Learn the importance of Human values.

23CSD04.CO3 Developing the overall personality.

23CSD04.CO4 Infer the importance of behavior development.

23CSD04.CO5 Know the self-management and good health.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSD04.CO1	-	-	-	-	-	X	X	X	-	X	-	X	-	-	-
23CSD04.CO2	-	-	-	-	-	X	X	X	-	X	X	-	-	X	-
23CSD04.CO3	-	-	-	-	-	X	X	X	X	X	X	-	-	-	-
23CSD04.CO4	-	-	-	-	-	X	X	X	-	X	-	X	-	-	-
23CSD04.CO5	-	-	-	-	-	X	X	X	-	X	-	X	-	-	-

Unit-I Values and Self-Development **5**

Social Values And Individual Attitudes -Work ethics, Indian vision of humanism- Moral and non- moral valuation- Standards and principles- Value judgments.

Unit-II Cultivation of Values **5**

Importance of cultivation of values – Sense of duty – Devotion – Self-reliance – Confidence –Concentration – Truthfulness – Cleanliness – Honesty – Humanity – Power of faith – National Unity –Patriotism – Love for nature –Discipline.

Unit-III Personality **5**

Personality and Behavior Development – Soul and Scientific attitude – Positive Thinking – Integrity and discipline – Punctuality – Love and Kindness – Avoid fault Thinking – Free from anger – Dignity of labour.

Unit-IV Behavior Development **5**

Universal brotherhood and religious tolerance – True friendship – Happiness Vs suffering – Love for truth – Aware of self-destructive habits – Association and Cooperation – Doing best for saving nature.

Unit-V Character and Competence **5**

Character and Competence – Holy books Vs Blind faith – Self-management and Good health – Science of reincarnation – Equality – Nonviolence – Humility – Role of Women – All religions and same message – Mind your Mind – Self-control Honesty – Studying effectively.

Total Periods: 25

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Y.K. Singh	Value Education	APH Publishing, New Delhi	2008
2.	R. P. Shukla,	Value education and human rights	Sarup & Sons, New Delhi, 1st edition	2004
3.	Chakroborty, S.K.	Values and Ethics for organizations Theory and practice	Oxford University Press, New Delhi	1998

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23CSD05	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	2

Course Objective:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and Humanitarian response
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country

Course Outcomes:

23CSD05.CO1	Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
23CSD05.CO2	Realize critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
23CSD05.CO3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
23CSD05.CO4	Understand the strengths and weaknesses of disaster management approaches, planning and Programming in different countries, particularly their home country.
23CSD05.CO5	Gain Knowledge in emerging trend mitigation of disasters.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23CSD05.CO1	X	-	X	X	X	-	X	-	-	X	-	-	X	-	-
23CSD05.CO2	X	X	X	X	-	X	-	X	-	-	X	-	-	X	-
23CSD05.CO3	X	X	-	-	-	X	-	X	-	X	X	-	X	-	-
23CSD05.CO4	X	-	X	-	X	-	-	-	-	-	-	X	-	X	-
23CSD05.CO5	X	X	X	-	X	-	X	X	-	-	-	-	X	-	-

Unit-I Introduction **5**

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II Repercussions of Disasters and Hazards **5**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease And Epidemics, War And Conflicts.

Unit-III Disaster Prone Areas in India **5**

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.

Unit-IV Disaster Preparedness and Management **5**

Preparedness: Monitoring of Phenomena Triggering A Disaster Or Hazard; Evaluation of Risk: Application of Remote Sensing.

Unit-V Risk Assessment **5**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Total Periods: 25

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R. Nishith, Singh AK	Disaster Management in India:Perspectives, issues and strategies	New Royal book Company	-
2.	Sahni, Pardeep et.al.(Eds.)	Disaster Mitigation ExperiencesAnd Reflections	Prentice Hall of India, New Delhi	-
3.	Goel S. L	Disaster Administration And Management Text And Case Studies	Deep & Deep Publication Pvt. Ltd,New Delhi	-

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