M.E. Computer Science and Engineering

Curriculum & syllabus

Excel
ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NBA and NAAC with "A+"and Recognized by UGC (2f&12B)
KOMARAPALAYAM - 637303
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
M E - COMPUTER SCIENCE AND ENGINEERING
REGULATION 2022
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULUM

I SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
22PMA103	Applied Probability and Statistics	FC	3	2	0	4	40	60	100
22PCS101	Data Visualization Techniques	PC	3	0	0	3	40	60	100
22PCS102	Natural Language Processing	PC	3	0	0	3	40	60	100
22PCS103	Advanced Data Structures and Algorithms	PC	3	2	0	4	40	60	100
22PCSEXX	Professional Elective I	PE	3	0	0	3	40	60	100
22PCSEXX	Professional Elective II	PE	3	0	0	3	40	60	100
Practical Course									
22PCS104	Advanced Data Structures Laboratory	PC	0	0	4	2	50	50	100
TOTAL			**20**	**4**	**4**	**22**	**290**	**410**	**700**

II SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
22PCS201	Artificial Intelligence and Machine Learning Techniques	PC	3	0	0	3	40	60	100
22PCS202	Internet of Things	PC	3	0	0	3	40	60	100
22PCS203	Advanced Cloud Computing Technologies	PC	3	0	0	3	40	60	100
22PCS204	Big Data Analytics	PC	3	0	0	3	40	60	100
22PCSEXX	Professional Elective III	PE	3	0	0	3	40	60	100
22PCSEXX	Professional Elective IV	PE	3	0	0	3	40	60	100
Practical Course									
22PCS205	Data Analytics Laboratory	PC	0	0	4	2	50	50	100
Employability Enhancement Course									
22PCS206	Technical Seminar and Internship	EEC	0	0	2	1	50	50	100
Total			**18**	**0**	**6**	**21**	**340**	**460**	**800**

III SEMESTER									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
22PEE301	Research Methodology and Intellectual Property Rights	PC	3	0	0	3	40	60	100
22PCSEXX	Professional Elective V	PE	3	0	0	3	40	60	100
22PCSEXX	Professional Elective VI	PE	3	0	0	3	40	60	100
Employability Enhancement Course									
22PCS301	Project Work Phase - I	EEC	0	0	12	6	50	50	100
TOTAL			**9**	**0**	**12**	**15**	**170**	**230**	**400**

IV SEMESTER									
Code No.	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Employability Enhancement Course									
22PCS401	Project Work Phase - II	EEC	0	0	24	12	50	50	100
Total			**0**	**0**	**24**	**12**	**50**	**50**	**100**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 70

CREDIT SUMMARY

S. No	**Category**	**CREDITS PER SEMESTER**				**Total Credit (AICTE)**	**Credits in %**
		I	**II**	**III**	**IV**		
1	**FC**	4				**4**	**6**
2	**PC**	12	14	3		**29**	**41**
3	**PE**	6	6	6		**18**	**26**
4	**EEC**		1	6	12	**19**	**27**
Total		**22**	**21**	**15**	**12**	**70**	**100**

FC - Foundation Course
PC - Professional Core
PE - Professional Electives
EEC - Employability Enhancement Courses
MC - Mandatory Courses (Non-Credit Courses)
CA - Continuous Assessment
FE - Final Examination

Professional Elective I - SEMESTER I									
Code No	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PCSE01	Advanced Computer Architecture	PE	3	0	0	3	40	60	100
22PCSE02	Advanced Database Technology	PE	3	0	0	3	40	60	100
22PCSE03	Web Engineering	PE	3	0	0	3	40	60	100
22PCSE04	Real time systems	PE	3	0	0	3	40	60	100
22PCSE05	Image Processing and Analysis	PE	3	0	0	3	40	60	100

Professional Elective II – SEMESTER I									
Code No	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PCSE11	Soft Computing	PE	3	0	0	3	40	60	100
22PCSE12	Information Retrieval Techniques	PE	3	0	0	3	40	60	100
22PCSE13	Data Warehousing and Data Mining	PE	3	0	0	3	40	60	100
22PCSE14	Parallel Programming Paradigms	PE	3	0	0	3	40	60	100
22PCSE15	Recommender System	PE	3	0	0	3	40	60	100

Professional Elective III – SEMESTER II									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PCSE21	Software Architectures And Design	PE	3	0	0	3	40	60	100
22PCSE22	Ethical Hacking	PE	3	0	0	3	40	60	100
22PCSE23	Data Encryption and Compression	PE	3	0	0	3	40	60	100
22PCSE24	Intellectual Property Rights	PE	3	0	0	3	40	60	100
22PCSE25	Data Preparation and Analysis	PE	3	0	0	3	40	60	100

Professional Elective IV – SEMESTER II									
Code No.	**Course**	**Category**	**Periods /Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PCSE31	Performance Analysis of Computer Systems	PE	3	0	0	3	40	60	100
22PCSE32	Service Oriented Architecture and Design	PE	3	0	0	3	40	60	100
22PCSE33	Computer Vision	PE	3	0	0	3	40	60	100
22PCSE34	Blockchain Technology	PE	3	0	0	3	40	60	100
22PCSE35	Software Quality Assurance and Testing	PE	3	0	0	3	40	60	100

Professional Elective V – SEMESTER III									
Code No.	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PCSE41	Formal models of software Systems	PE	3	0	0	3	40	60	100
22PCSE42	Embedded Software Development	PE	3	0	0	3	40	60	100
22PCSE43	Machine Learning Techniques	PE	3	0	0	3	40	60	100
22PCSE44	Bio-inspired Computing	PE	3	0	0	3	40	60	100
22PCSE45	Big Data Query Languages	PE	3	0	0	3	40	60	100

Professional Elective VI – SEMESTER III									
Code No.	**Course**	**Category**	**Periods / Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
22PCSE51	Data Intensive Computing	PE	3	0	0	3	40	60	100
22PCSE52	Reconfigurable Computing	PE	3	0	0	3	40	60	100
22PCSE53	Mobile Application Development	PE	3	0	0	3	40	60	100
22PCSE54	Bio Informatics	PE	3	0	0	3	40	60	100
22PCSE55	Information Storage Management	PE	3	0	0	3	40	60	100

SEMESTER I

22PMA103	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		3	2	0	4
Nature of Course	Foundation Courses				
Pre requisites	Fundamentals of Basic Mathematics				

Course Objectives

1. This course is designed to provide the solid foundation on topics in applied probability and various statistical methods
2. Understand concepts which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling.
3. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand basic probability axioms and rules and the moments of discrete and continuous random variables.	Understand
CO2.	Demonstrate consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.	Apply
CO3.	Use statistical tests in testing hypotheses on data.	Apply
CO4.	Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.	Apply
CO5.	Use mathematical sciences including statistics, modern optimization methods and risk modeling.	Apply

Course Contents:

Unit I Probability And Random Variables 12

Probability – Axioms of probability – Conditional probability – Baye's theorem - 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 II Two Dimensional Random Variables 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

Unit III Estimation Theory 12

Unbiased estimators – Method of moments – Maximum likelihood estimation --Curve fitting by principle of least squares – Regression lines.

Unit IV Testing Of Hypothesis 12

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

Unit V Multivariate Analysis 12

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components- Population principal components – Principal components from standardized variables

Total: 60 Periods

Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	3							3	1	3	1	2
CO2	3	3	2	3							3	1	3	1	2
CO3	3	3	2	3							3	1	3	1	2
CO4	3	3	2	3							3	1	3	1	2
CO5	3	3	2	3							3	1	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCS101	DATA VISUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Big Data				

Course Objectives

The course is intended to

1. Comprehend how accurately represent voluminous complex data set in web sources.
2. Learn the methodologies used to visualize large data sets.
3. Identify the process involved in data visualization.
4. Incorporate the knowledge of various interaction techniques.
5. Study the security aspects involved in data visualization.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Design and use various methodologies present in data visualization.	Apply
CO2.	Make use of the methodologies in the data visualization.	Analyze
CO3.	Apply appropriate visualization techniques.	Apply
CO4.	Choose interactive data in the visualization.	Apply
CO5.	Analyze the process involved and security issues present in data visualization.	Analyze

Course Contents:

Unit - I Introduction 9

Context of data visualization - Definition, Methodology, Visualization design objectives. Key Factors - Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

Unit – II Visualizing Data Methods 9

Mapping - Time series - Connections and correlations - Scatter plot maps --Trees, Hierarchies and Recursion Networks and Graphs, Info graphics

Unit - III Visualizing Data Process 9

Acquiring data--Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads.

Unit – IV Advanced Data Process 9

Advanced Web Techniques, Parsing data - Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Vectors and Geometry, Binary Data Formats, Advanced Detective Work

Unit - V Interactive Data Visualization 9

Drawing with data -Scales - Axes -Updates, Transition and Motion - Interactivity--Layouts – Geomapping – Exporting, Framework D3.js, tableau, Google chart-Jupyter.

Total: 45 Periods

Text Books:

1. Ben Fry, “Visualizing Data: Exploring and Explaining Data with the Processing Environment”, O"Reilly Media, Inc., 3rd Edition 2019.

2. Scott Murray, “Interactive data visualization for the web”, O‟Reilly Media, Inc., 2nd edition, 2017.

Reference Book:

1. Chen, Hauser.M and H. Rheingans, “Foundations of Data Visualization”, Springer, 2ndEdition 2020.
2. Greg Conti, “Security Data Visualization: Graphical Techniques for Network Analysis”, No Starch Press Inc, 4th Edition 2018.
3. ChandrajitBajaj,”Data Visualization Techniques”, Wiley-Blackwell Publisher, 2ndEdition 2016.

Additional References:

1. https://www.tableau.com/learn/training
2. https://www.datacamp.com/community/tutorials/tutorial-jupyter-notebook
3. https://www.tutorialspoint.com/d3js/

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
Cos	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3		3	2	2								3	1	
CO2	3	3	2	2									3	1	
CO3	3	2		3									3	1	2
CO4	3	2		3	2								3	1	2
CO5	3		3	2									3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCS102	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Formal Language Automata Theory				

Course Objectives

The course is intended to

1. Learn the fundamentals of natural language processing
2. Understand the role of NLP components
3. Appreciate the use of CFG and PCFG in NLP
4. Incorporate the knowledge of statistical processing for real-time applications
5. Study about the different types of NLP applications

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Tag a given text with basic Language features	Understand
CO2.	Design an innovative application using NLP components	Apply
CO3.	Implement a rule based system to tackle morphology/syntax of a language	Apply
CO4.	Design a tag set to be used for statistical processing for real-time applications	Apply
CO5.	Compare and contrast use of different statistical approaches for different types of NLP applications	Analyze

Course Contents:

UNIT I INTRODUCTION **9**

Words - Regular Expressions and Automata - Words and Transducers - N-grams Part-of-Speech - Tagging Hidden Markov and Maximum Entropy Models

UNIT II SPEECH **9**

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition -- Advanced Topics Computational Phonology

UNIT III SYNTAX **9**

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

UNIT IV SEMANTICS AND PRAGMATICS **9**

The Representation of Meaning - Computational Semantics - Lexical Semantics Computational Lexical Semantics Computational Discourse

UNIT V APPLICATIONS **9**

Information Extraction - Question Answering and Summarization --Dialogue and Conversational Agents Machine Translation

Total: 45 Periods

Reference Books:

1. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.

2. Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.
3. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
4. Richard M Reese, "Natural Language Processing with Java", O_Reilly Media, 2015.
5. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", First Edition, O_Reilly Media, 2009.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2		1	2	3	1	2
CO2	3	3	3	3	3				2		1	2	3	1	2
CO3	3	3	3	3	3				2		1	2	3	1	2
CO4	3	3	3	3	3				2		1	2	3	1	2
CO5	3	3	3	3	3				2		1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCS103	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Data Structures				

Course Objectives

1. To understand the usage of algorithms in computing.
2. To learn and use hierarchical data structures and its operations
3. To learn the usage of graphs and its applications.
4. To select and design data structures and algorithms that is appropriate for problems.
5. To study about NP Completeness of problems.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Design data structures and algorithms to solve computing problems	Understand
CO2.	Use hierarchical data structures and its operations	Apply
CO3.	Apply the usage of graphs and its applications.	Apply
CO4.	Design algorithms using data structure and various string matching algorithms to solve real-life problems	Apply
CO5.	Apply suitable design strategy for problem solving	Apply

Course Contents:

Unit I Role of Algorithms in Computing **12**

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

Unit II Hierarchical Data Structures **12**

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

Unit III Graphs **12**

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

Unit IV Algorithm Design Techniques **12**

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

Unit V NP Complete and NP Hard **12**

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

Total: 60 Periods

Reference Books:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006
2. Robert Sedgewick and Kevin Wayne, “ALGORITHMS”, Fourth Edition, Pearson Education
3. S.Sridhar,”Design and Analysis of Algorithms”, First Edition, Oxford University Press. 2014
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice-Hall, 2011.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	3	3	1	2
CO2	3	3	3	3	1						1	3	3	1	2
CO3	3	3	3	3	1						1	3	3	1	2
CO4	3	3	3	3	1						1	3	3	1	2
CO5	3	3	3	3	1						1	3	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	**10**	**10**	**10**	**20**
Understand	**10**	**10**	**10**	**20**
Apply	**30**	**30**	**30**	**60**
Analyze	**0**	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**	**0**
Create	**0**	**0**	**0**	**0**

22PCS104	ADVANCED DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2
Nature of Course	Professional Core				
Pre requisites	Basics of Java or C or C++				

Course Objectives

The course is intended to

1. To acquire the knowledge of using advanced tree structures.
2. To learn the usage of heap structures.
3. To understand the usage of graph structures and spanning trees.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
1	Design and implement basic and advanced data structures extensively	Understand
2	To introduce mathematical aspects and implement solutions for specific problem	Understand
3	Design algorithms using graph structures	Understand
4	Design and develop efficient algorithms with minimum complexity using design techniques	Understand
5	To implement the different algorithmic design techniques	Understand

Course Content:

List of Exercises

S.No	List of Exercises	CO Mapping	RBT
1	Implementation of Merge Sort and Quick Sort-Analysis	3	Apply
2	Implementation of a Binary Search Tree	3	Apply
3	Red-Black Tree Implementation	3	Apply
4	Heap Implementation	3	Apply
5	Fibonacci Heap Implementation	3	Apply
6	Graph Traversals	3	Apply
7	Spanning Tree Implementation	3	Apply
8	Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)	3	Apply
9	Implementation of Matrix Chain Multiplication	3	Apply
10	Activity Selection and Huffman Coding Implementation	3	Apply

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				3	3	2	1	3	2	2
CO2	3	3	3	3	3				3	3	2	1	3	2	2
CO3	3	3	3	3	3				3	3	2	1	3	2	2
CO4	3	3	3	3	3				3	3	2	1	3	2	2
CO5	3	3	3	3	3				3	3	2	1	3	2	2
	3	High				2	Medium					1	Low		

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand		
Apply	70	70
Analyze		
Evaluate		
Create		

SEMESTER II

22PCS201	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Foundations of Artificial Intelligence				

Course Objectives:

The course is intended to

1. Incorporate the basic concepts and techniques of Machine Learning.
2. Study the Supervised and Unsupervised learning techniques.
3. Learn the various probabilities based learning techniques.
4. Assimilate the Advanced Techniques of Artificial Techniques Using Machine Learning Techniques graphical models of machine learning algorithms.
5. Acquire the knowledge on Components Using Genetic Algorithms.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Interpreting the Basic concepts of Machine learning with types.	Understand
CO2.	Compare the solutions for Dynamic Reduction and Component analysis using Genetic Algorithms.	Analyzing
CO3.	Implement different Ways to combine Tree and Probabilistic models with Algorithms	Apply
CO4.	Examine the functions using Practical examples of MLP	Analyze
CO5.	Modify existing machine learning algorithms to improve Proposal using Artificial Neural Networks in Machine Learning.	Create

COURSE CONTENTS:

UNIT- I Introduction **9**

Learning – Types of Machine Learning – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants, Perception, Separability and Regression.

UNIT-II Dimensionality Reduction and Evolutionary Models **9**

Dimensionality Reduction techniques – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring---Genetic Operators – Using Genetic Algorithms – Reinforcement Learning.

UNIT-III Tree and Probabilistic Models **9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Statistics models.

UNIT-IV Linear Models **9**

Multi-layer Perception – Back Propagation Error – Deriving Back- Propagation – Radial Basis Functions and Splines– RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT V Artificial Neural Networks in Machine Learning and Graph Models **9**

Artificial of Neural Networks Applications-Machine Techniques Using Artificial Networks Models-Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Graphical Models – Bayesian Networks – Hidden Markov Models – Tracking Methods

TOTAL: 45 Periods

Text Books:

1. EthemAlpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", MIT Press, 3rd Edition 2019.
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2nd Edition 2017.

Reference Books:

1. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", Wiley,1st Edition 2020
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Chapman and Hall/CRC, 2nd Edition 2019.
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, 2ndEdition 2017.

Additional References:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://onlinecourses.nptel.ac.in/noc21_cs24/preview
3. https://nptel.ac.in/courses/106/105/106105152/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2									1	3	1	
CO2	3	3	2									1	3	1	
CO3	3	3	2									1	3	1	
CO4	3	3	2									1	3	1	
CO5	3	3	2									1	3	1	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCS202	INTERNET OF THINGS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Networks				

Course Objectives

The course is intended to

1. Learn the basic architecture and concepts till Third Generation Communication systems.
2. Understand the latest 4G Telecommunication System Principles.
3. Introduce the broad perspective of pervasive concepts and management
4. Explore the HCI in Pervasive environment
5. Apply the pervasive concepts in mobile environment

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Analyze various protocols for IoT	Analyze
CO2.	Develop web services to access/control IoT devices.	Apply
CO3.	Design a portable IoT using Rasperry Pi	Apply
CO4.	Deploy an IoT application and connect to the cloud.	Apply
CO5.	Analyze applications of IoT in real time scenario	Analyze

Course Contents:

Unit IIntroduction to IoT **9**

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

Unit II IoT Architecture **9**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture -- IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

Unit III IoT Protocols **9**

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

Unit IVBuilding IoT with Raspberry Pi &Arduino **9**

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

Unit V Case Studies And Real-World Applications **9**

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

Total: 45 Periods

Reference Books:

1. ArshdeepBahga, Vijay Madisetti, ¯Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ¯Architecting the Internet of Things‖, Springer, 2011
3. Honbo Zhou, ¯The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
4. Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , ¯The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1			3		1	1	2	3	1	2
CO2	3	3	3	3	1			3		1	1	2	3	1	2
CO3	3	3	3	3	1			3		1	1	2	3	1	2
CO4	3	3	3	3	1			3		1	1	2	3	1	2
CO5	3	3	3	3	1			3		1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCS203	ADVANCED CLOUD COMPUTING TECHNOLOGIES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Distributed Systems				

Course Objectives

The course is intended to

1. Understand the concepts of virtualization and virtual machines
2. Gain expertise in server, network and storage virtualization.
3. Deploy practical virtualization solutions and enterprise solutions
4. Incorporate knowledge on the concept of programming models for cloud computing
5. Study the security issues in the cloud environment

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Employ the concepts of storage virtualization, network virtualization and its management	Understand
CO2.	Apply the concept of virtualization in the cloud computing	Apply
CO3.	Identify the architecture, infrastructure and delivery models of cloud computing	Understand
CO4.	Develop services using Cloud computing	Apply
CO5.	Apply the security models in the cloud environment	Apply

Course Contents:

Unit I Virtualization **9**

Basics of Virtual Machines- Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation- Taxonomy of Virtual Machines. Virtualization –Management Virtualization – Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

Unit II Virtualization Infrastructure **9**

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

Unit III Cloud Platform Architecture **9**

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

Unit IVProgramming Model **9**

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments Eucalyptus, Open Nebula, Open Stack, Nimbus

Unit V Cloud Security **9**

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management

Total: 45 Periods

Reference Books:

1. Danielle Ruest, Nelson Ruest, ¯Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Tim Mather, SubraKumaraswamy, and ShahedLatif ,"Cloud Security and Privacy", O‘Reilly Media, Inc.,2009.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
7. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3		2	2	2			2	3	1	2
CO2	3	3	3	3	3		2	2	2			2	3	1	2
CO3	3	3	3	3	3		2	2	2			2	3	1	2
CO4	3	3	3	3	3		2	2	2			2	3	1	2
CO5	3	3	3	3	3		2	2	2			2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCS204	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Data Mining				

Course Objectives

The course is intended

1. To understand the competitive advantages of big data analytics
2. To understand the big data frameworks
3. To learn data analysis methods
4. To learn stream computing
5. To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand how to leverage the insights from big data analytics	Understand
CO2.	Use the big data frameworks in real life problems	Apply
CO3.	Analyze data by utilizing various statistical and data mining approaches	Analyze
CO4.	Perform analytics on real-time streaming data	Apply
CO5.	Use the various NoSql alternative database models	Apply

Course Contents:

Unit I Introduction to Big Data **9**

Big Data – Definition, Characteristic Features – Big Data Applications Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems--Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods Analysis vs Reporting Modern Data Analytic Tools

Unit II Hadoop Framework **9**

Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

Unit III Data Analysis **9**

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

Unit IVMining Data Streams **9**

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies Real Time Sentiment Analysis, Stock Market Predictions

Unit V Big Data Frameworks **9**

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries

Total: 45 Periods

Reference Books:

1. Bill Franks, ¯Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, ¯Intelligent Data Analysis‖, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	3	3				1	1	2	3	1	2
CO2	3	3	3	2	3	3				1	1	2	3	1	2
CO3	3	3	3	2	3	3				1	1	2	3	1	2
CO4	3	3	3	2	3	3				1	1	2	3	1	2
CO5	3	3	3	2	3	3				1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCS205	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2
Nature of Course	Professional Core				
Pre requisites	Basics of Java or C or C++				

Course Objectives

The course is intended

1. To implement Map Reduce programs for processing big data
2. To realize storage of big data using H base, Mongo DB
3. To learn big data using linear models
4. To study big data using machine learning techniques
5. To focus on graphical data analysis

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
1	Process big data using Hadoop framework	Understand
2	Build and apply linear and logistic regression models	Understand
3	Use the storage of big data using H base, Mongo DB	Understand
4	Perform data analysis with machine learning methods	Understand
5	Perform graphical data analysis	Understand

Course Content:

List of Exercises

S.No	List of Exercises	CO Mapping	RBT
1	Install, configure and run Hadoop and HDFS	3	Apply
2	Implement word count / frequency programs using MapReduce	3	Apply
3	Implement an MR program that processes a weather dataset	3	Apply
4	Implement Linear and logistic Regression	3	Apply
5	Implement SVM / Decision tree classification techniques	3	Apply
6	Implement clustering techniques	3	Apply
7	Visualize data using any plotting framework	3	Apply
8	Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.	3	Apply

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3				3	3	2	1	3	2	2
2	3	3	3	3	3				3	3	2	1	3	2	2
3	3	3	3	3	3				3	3	2	1	3	2	2
4	3	3	3	3	3				3	3	2	1	3	2	2
5	3	3	3	3	3				3	3	2	1	3	2	2
	3	High				2	Medium					1	Low		

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand		
Apply	70	70
Analyze		
Evaluate		
Create		

22PCS206	TERM PAPER WRITING AND SEMINAR	L	T	P	C
		0	0	2	1
Nature of Course	Professional Core				
Pre requisites	Document writing				

Course Objectives

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles.

A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas.

The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				3	3	2	1	3	2	2
CO2	3	3	3	3	3				3	3	2	1	3	2	2
CO3	3	3	3	3	3				3	3	2	1	3	2	2
CO4	3	3	3	3	3				3	3	2	1	3	2	2
CO5	3	3	3	3	3				3	3	2	1	3	2	2
	3	High				2	Medium					1	Low		

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand		
Apply	70	70
Analyze		
Evaluate		
Create		

22PCSE01	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Architecture				

Course Objectives

The course is intended

1. To identify the limitations of ILP.
2. To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
3. To learn the different multiprocessor issues.
4. To expose the different types of multicore architectures.
5. To understand the design of the memory hierarchy.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Discuss the issues related to multiprocessing and suggest solutions	Understand
CO2.	Point out the salient features of different multicore architectures and how they exploit parallelism.	Analyze
CO3.	Discuss the various techniques used for optimizing the cache performance	Understand
CO4.	Design hierarchal memory system	Apply
CO5.	Evaluate how data level parallelism is exploited in architectures	Evaluate

Course Contents:

Unit I Fundamentals Of Computer Design And ILP 9

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

Unit II Memory Hierarchy Design 9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

Unit III Multiprocessor Issues 9

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

Unit IV Multicore Architectures 9

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

Unit V Vector, SIMD And GPU Architectures 9

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

Total: 45 Periods

Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	2	3	1	2
CO2	3	3	3	3	1						1	2	3	1	2
CO3	3	3	3	3	1						1	2	3	1	2
CO4	3	3	3	3	1						1	2	3	1	2
CO5	3	3	3	3	1						1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE02	ADVANCED DATABASE TECHNOLOGY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Database systems				

Course Objectives

The course is intended

1. To understand the database system concept.
2. To learn the concepts of relational databases and its applications.
3. To acquire Knowledge on distributed data bases and its applications.
4. To learn the concepts of object relational databases.
5. To understand the concept of XML databases.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Recognize the basics of database system concepts and data models.	Understand
CO2.	Examine the relational database system design	Analyze
CO3.	Use the distributed databases, client server databases and parallel databases.	Apply
CO4.	Apply the object and object relational databases.	Apply
CO5.	Obtain the knowledge of XML databases and data ware housing.	Apply

Course Contents:

Unit I Data Base System Concept 9

File systems - Database systems - Database systems architecture - Data models Relational model – Hierarchical model - Network model - Entity-Relationship model - Data Dictionary Database Administration and control.

Unit II Relational Database System Design 9

Domains and key concept - Integrity rules - Relational Algebra Commercial query languages – Embedded SQL - Normalization and database design. File and storage structures Indexing and Hashing – Query processing

Unit III Distributed Databases 9

Centralized Versus Distributed Databases – Fragmentation – Distributed database architecture – Client / Server databases – Distributed transactions – Locking and Commit protocols – Distributed concurrency Control – Security and reliability – Parallel databases

Unit IV Object and Object Relational Databases 9

Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended Relational Systems: Object Relational features in SQL/Oracle – Case Studies

Unit V XML Databases 9

XML Databases: XML Data Model – DTD - XML Schema - XML Querying – Web Databases – JDBC – Information Retrieval – Datamining – Datawarehousing.

Total: 45 Periods

Reference Books:

1. ElmasriR. NavatheS.B., “Fundamentals of Database Systems”, Fifth Edition, Pearson Education/Addison Wesley, 2007.
2. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Fifth Edition, McGraw Hill, 2006.
3. SubramanianV.S., “Principles of Multimedia Database Systems”, Harcourt India Pvt Ltd., 2001
4. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	3	3	1	2
CO2	3	3	3	3	1						1	3	3	1	2
CO3	3	3	3	3	1						1	3	3	1	2
CO4	3	3	3	3	1						1	3	3	1	2
CO5	3	3	3	3	1						1	3	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE03	WEB ENGINEERING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Web Technology				

Course Objectives

The course is intended to

1. Understand the characteristics of web applications
2. Learn to Model web applications
3. Be aware of Systematic design methods
4. Be familiar with the testing techniques for web applications
5. Incorporate knowledge on web project management

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Implement different characteristics of web applications	Apply
CO2.	Model web applications	Apply
CO3.	Design web applications	Apply
CO4.	Test web applications	Apply
CO5.	Promote web applications and use web project management	Apply

Course Contents:

UNIT I INTRODUCTION TO WEB ENGINEERING 9

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

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9

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

UNIT III WEB APPLICATION DESIGN 9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines-Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design-Wep App Functionality- Design Process- Functional Architecture- Detailed Functional Design.

UNIT IV TESTING WEB APPLICATIONS 9

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

UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9

Introduction-challenges in launching the web Application-Promoting Web Application-Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS web sockets.

Total: 45 Periods

Reference Books:

1. Chris Bates, ―Web Programming: Building Internet Applications‖, Third Edition, Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, ―Web Engineering‖, John Wiley and Sons Ltd, 2006.
3. Guy W. Lecky-Thompson, ―Web Programming‖, Cengage Learning, 2008.
4. John Paul Mueller, ―Web Development with Microsoft Visual Studio 2005‖, Wiley Dream tech, 2006.
5. Roger S. Pressman, David Lowe, ―Web Engineering‖, Tata McGraw Hill Publication, 2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	3	3	1	2
CO2	3	3	3	3	1						1	3	3	1	2
CO3	3	3	3	3	1						1	3	3	1	2
CO4	3	3	3	3	1						1	3	3	1	2
CO5	3	3	3	3	1						1	3	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE04	REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Architecture				

Course Objectives

The course is intended to

1. Learn real time operating system concepts, the associated issues & Techniques.
2. Understand design and synchronization problems in Real Time System.
3. Explore the concepts of real time databases.
4. Evaluation techniques present in Real Time System.
5. Develop the evaluation techniques present in Real Time System.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Apply principles of real time system design techniques to develop real time applications.	Apply
CO2.	Analyze design and synchronization problems in Real Time System.	Analyze
CO3.	Make use of database in real time applications	Apply
CO4.	Make use of architectures and behavior of real time operating systems	Apply
CO5.	Apply evaluation techniques in application	Apply

Course Contents:

Unit I Real time system and Scheduling 9

Introduction- Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

Unit II Software Requirements Engineering 9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision.

Unit III Intertask Communication and Memory Management 9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage.

Unit IV Real time Databases 9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two- phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems

Unit V Evaluation Techniques and Clock Synchronization 9

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy–Software error models. Clock Synchronization–Clock, A Nonfault-Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software

Total: 45 Periods

Reference Books:

1. C.M. Krishna, Kang G. Shin, ―Real-Time Systems‖, McGraw-Hill International Editions, 1997
2. Philip.A.Laplante, ―Real Time System Design and Analysis‖, Prentice Hall of India, 3rd Edition, 2004
3. Rajib Mall, ―Real-time systems: theory and practice‖, Pearson Education, 2009
4. R.J.A Buhur, D.L Bailey, ―An Introduction to Real-Time Systems‖, Prentice Hall International, 1999
5. Stuart Bennett, ―Real Time Computer Control-An Introduction‖, Prentice Hall of India, 1998
6. Allen Burns, Andy Wellings, ―Real Time Systems and Programming Languages‖, Pearson Education, 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	3	3	1	2
CO2	3	3	3	3	1						1	3	3	1	2
CO3	3	3	3	3	1						1	3	3	1	2
CO4	3	3	3	3	1						1	3	3	1	2
CO5	3	3	3	3	1						1	3	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE05	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Computer Graphics and Multimedia				

Course Objectives

The course is intended to

1. To understand the image processing concepts and analysis
2. To understand the image processing techniques
3. To study the use of MATLAB and its equivalent open source tools
4. To familiarize the image processing environment and their applications,
5. To appreciate the use of image processing in various applications

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Design and implement algorithms for image processing applications	Understand
CO2.	Incorporates different concepts of medical Image Processing	Apply
CO3.	Familiar with the use of MATLAB and its equivalent open source tools	Apply
CO4.	Critically analyze different approaches to image processing applications	Apply
CO5.	Explore the possibility of applying Image processing concepts in various applications	Apply

Course Contents:

UNIT I IMAGE PROCESSING FUNDAMENTALS **9**

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System- Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models Image Operations – Arithmetic, logical, statistical and spatial operations

UNIT II IMAGE ENHANCEMENT AND RESTORATION **9**

Image Transforms Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain- Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY **9**

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION **9**

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification

UNIT V IMAGE REGISTRATION AND VISUALIZATION **9**

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

Total: 45 Periods

Reference Books:

1. Alasdair McAndrew, ―Introduction to Digital Image Processing with Matlab‖, Cengage Learning 2011,India
2. Anil J Jain, ―Fundamentals of Digital Image Processing‖, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor,‖ Biomedical signals and Image processing‖,CRC – Taylor and Francis, New York, 2006
4. Rafael C.Gonzalez and Richard E.Woods, ―Digital Image Processing‖, Third Edition, Pearson Education, 2008, New Delhi
5. S.Sridhar, ―Digital Image Processing‖, Oxford University Press, 2011 .

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	3	3	1	2
CO2	3	3	3	3	1						1	3	3	1	2
CO3	3	3	3	3	1						1	3	3	1	2
CO4	3	3	3	3	1						1	3	3	1	2
CO5	3	3	3	3	1						1	3	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE11	SOFT COMPUTING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Artificial Intelligence				

Course Objectives

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario
2. To implement soft computing based solutions for real-world problems
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms
4. To provide student a hand-on experience on MATLAB to implement various strategies

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Identify and describe soft computing techniques and their roles in building intelligent machines	Understand
CO2.	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems	Apply
CO3.	Apply genetic algorithms to combinatorial optimization problems	Apply
CO4.	Evaluate and compare solutions by various soft computing approaches for a given problem	Evaluate
CO5.	Apply the knowledge of soft computing techniques in artificial neural networks and fuzzy logic	Apply

Course Contents:

Unit I Introduction to Soft Computing and Neural Networks **9**

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence Machine Learning Basics

Unit II Fuzzy Logic **9**

Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit III Neural Networks **9**

Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Unit IV Genetic Algorithms **8**

Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Unit V Matlab/Python Lib **10**

Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic. **Recent Trends:** Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Total: 45 Periods

Reference Books:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	3	3				1	1	2	3	1	2
CO2	3	3	3	2	3	3				1	1	2	3	1	2
CO3	3	3	3	2	3	3				1	1	2	3	1	2
CO4	3	3	3	2	3	3				1	1	2	3	1	2
CO5	3	3	3	2	3	3				1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE12	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of DBMS				

Course Objectives

1. To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
2. To get an understanding of machine learning techniques for text classification and clustering.
3. To understand the various applications of information retrieval giving emphasis to multimedia R, web search
4. To understand the concepts of digital libraries

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Build an Information Retrieval system using the available tools.	Understand
CO2.	Identify and design the various components of an Information Retrieval system.	Apply
CO3.	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.	Apply
CO4.	Design an efficient search engine and analyze the Web content structure	Apply
CO5.	To use and analyze the concepts of digital libraries	Analyze

Course Contents:

Unit I Introduction 9

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

Unit II Modeling 9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

Unit III Indexing 9

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

Unit IV Classification and Clustering 9

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

Unit V Searching the Web 9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

.**Total: 45 Periods**

Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE13	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Networks				

Course Objectives

1. To learn the concept of data warehousing and mining techniques
2. To incorporate knowledge on different clustering methods
3. To study Time series Data and extracting knowledge
4. To understand analysis of Social Network Data
5. To familiar with types of web mining

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand the concept of data warehousing and mining techniques	Understand
CO2.	Gain knowledge on different clustering methods	Understand
CO3.	Perform analytics on Time series Data and extracting knowledge	Apply
CO4.	Illustrate pattern mining in stream data and Analysis of Social Network Data	Apply
CO5.	Explain the extracting of information from the web data and types of web mining	Apply

Course Contents:

Unit I Introduction to Data Warehousing **9**

Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods.

Unit II Classification and Prediction **9**

Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns.

Unit III Mining Time Series Data **8**

Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis

Unit IV Mining Data Streams **9**

Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis

Unit V Web Mining **10**

Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining. Recent Trends: Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

.**Total: 45 Periods**

Reference Books:

1. Jiawei Han and M Kamber, “Data Mining Concepts and Techniques”, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, “Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach”, Addison Wesley, 2006.

3. G. Dong and J Pei, “Sequence Data Mining”, Springer, 2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE14	PARALLEL PROGRAMMING PARADIGMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Architecture				

Course Objectives

1. To familiarize the issues in parallel computing.
2. To describe distributed memory programming using MPI.
3. To understand shared memory paradigm with Pthreads and with OpenMP.
4. To learn the GPU based parallel programming using OpenCL.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Identify issues in parallel programming.	Understand
CO2.	Develop distributed memory programs using MPI framework.	Apply
CO3.	Use Shared Memory Paradigm With Pthreads	Apply
CO4.	Design and develop shared memory parallel programs using Pthreads and using OpenMP.	Apply
CO5.	Implement Graphical Processing OpenCL programs	Apply

Course Contents:

Unit I Foundations Of Parallel Programming **9**

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

Unit II Distributed Memory Programming With MPI **9**

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD- programs- MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication --MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management –performance evaluation of MPI programs- A Parallel Sorting Algorithm

.

Unit III Shared Memory Paradigm WithPthreads **9**

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples Caches, cache coherence and false sharing – Thread safety-Pthreads case study.

Unit IV Shared Memory Paradigm: Openmp **9**

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search

Unit V **9**

Graphical Processing Paradigms: Opencl And Introduction To Cuda: Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts ---OpenCL programming – Built-In Functions- Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object case study. Introduction to CUDA programming

.**Total: 45 Periods**

Reference Books:

1. M. J. Quinn, ¯Parallel programming in C with MPI and OpenMP‖, Tata McGraw Hill, 2003.
2. A.Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, ¯OpenCL programming guide‖, Addison Wesley, 2011
3. Peter S. Pacheco, ¯An introduction to parallel programming‖, Morgan Kaufmann, 2011.
4. Rob Farber, ¯CUDA application design and development‖, Morgan Haufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, ¯Using MPI: Portable parallel programming with the message passing interface‖, Second Edition, MIT Press, 1999

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE15	RECOMMENDER SYSTEM	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Information Retrieval Techniques				

Course Objectives

1. To understand the various searching techniques
2. To learn the various types of content based filtering and collaborative filtering
3. To learn the various hybridization design
4. To acquire the knowledge of evaluating recommender system
5. To learn the various types of recommender system

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Learn the key concepts of information retrieval, various searching techniques	Understand
CO2.	Gain the knowledge of various types of content based filtering and collaborative filtering	Understand
CO3.	Deploy the various hybridization design	Apply
CO4.	Model the knowledge of evaluating recommender system	Apply
CO5.	Implement the various types of recommender system	Apply

Course Contents:

Unit I Introduction **9**

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

Unit II Content-based Filtering and Collaborative Filtering **10**

High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms. Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

Unit III Hybrid Approaches **8**

Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Metalevel, Limitations of hybridization strategies.

Unit IV Evaluating Recommender System **9**

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

Unit V Types of Recommender Systems **9**

Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems.

.

.**Total: 45 Periods**

Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE21	SOFTWARE ARCHITECTURES AND DESIGN	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Software Engineering				

Course Objectives

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

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Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand the need of software architecture for sustainable dynamic systems.	Understand
CO2.	Have a sound knowledge on design principles and to apply for large scale systems	Understand
CO3.	Design architectures for distributed heterogeneous systems	Apply
CO4.	Have good knowledge on service oriented and model driven architectures and the aspect oriented architecture	Understand
CO5.	Have a working knowledge to develop appropriate architectures through various case studies.	Apply

Course Contents:

Unit IIntroduction to Software Architecture **9**

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

Unit II Object-Oriented Paradigm **9**

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

Unit III Distributed Architecture **9**

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

Unit IVArchitecture of User Interfaces containers **9**

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

Unit V Aspect Oriented Architectures **9**

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

.**Total: 45 Periods**

Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE22	ETHICAL HACKING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of DBMS				

Course Objectives

Introduces the concepts of Ethical Hacking and gives the students the opportunity to learn about different tools and techniques in Ethical hacking and security and practically apply some of the tools..

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand the basic ethics of Ethical Hacking	Understand
CO2.	Understand the Ethical Testing and their Tools	Understand
CO3.	Identify and analyse Vulnerabilities and advance Reverse Engineering	Analyze
CO4.	Understand the Client-Side browser and their Vulnerability	Understand
CO5.	Analyse the knowledge of Malware	Analyze

Course Contents:

Unit I **9**

Introduction to Ethical Disclosure: Ethics of Ethical Hacking, Ethical Hacking and the legal system, Proper and Ethical Disclosure

Unit II **9**

Penetration Testing and Tools: Using Metasploit, Using BackTrackLiveCD Linux Distribution

Unit III **9**

Vulnerability Analysis: Passive Analysis, Advanced Static Analysis with IDA Pro, Advanced Reverse Engineering

Unit IV **9**

Client-side Browser Exploits: Exploiting Windows Access Control Model for Local Elevation Privilege, Intelligent Fuzzing with Sulley, From Vulnerability to Exploit.

Unit V **9**

Malware Analysis: Collecting Malware and Initial Analysis, Hacking Malware **Case Study:** Case study of vulnerability of cloud platforms and mobile platforms & devices.

.**Total: 45 Periods**

Reference Books:

1. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez
2. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE23	DATA ENCRYPTION AND COMPRESSION	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of CNS				

Course Objectives

1. Understand the basic needs of Security and types of attacks
2. Realize the Encryption techniques, Symmetric and Asymmetric key Cryptography
3. Analyze the User Authentication Mechanism
4. Understand the Public –key Cryptography and Message Authentication
5. Recognize the Data Compression techniques and Entropy encoding

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand the basic needs of Security and types of attacks	Understand
CO2.	Implement the Encryption techniques, Symmetric and Asymmetric key Cryptography	Apply
CO3.	Analyze the User Authentication Mechanism	Analyze
CO4.	Develop Public –key Cryptography and Message Authentication	Apply
CO5.	Apply Data Compression techniques and Entropy encoding	Apply

Course Contents:

Unit I Introduction to Security **9**

Need for security, Security approaches, Principles of security, Types of attacks. **Encryption Techniques:** Plaintext, Cipher text, Substitution & Transposition techniques, Encryption & Decryption, Types of attacks, Key range & Size

Unit II Symmetric and Asymmetric Key Cryptography **7**

Algorithm types & Modes, DES, IDEA, Differential & Linear Cryptanalysis, RSA, Symmetric & Asymmetric key together, Digital signature, Knapsack algorithm

Unit III User Authentication Mechanism **10**

Authentication basics, Passwords, Authentication tokens, Certificate based & Biometric authentication, Firewall. **Case Studies of Cryptography:** Denial of service attacks, IP spoofing attacks, Secure inter branch payment transactions, Conventional Encryption and Message Confidentiality, Conventional Encryption Principles, Conventional Encryption Algorithms, Location of Encryption Devices, Key Distribution. **Public Key Cryptography and Message Authentication:** Approaches to Message Authentication, SHA-1, MD5, Public-Key Cryptography Principles, RSA, Digital, Signatures, Key Management

Unit IV Data compression **9**

Introduction, Need for data compression, Fundamental concept of data compression & coding, Communication model, Compression ratio, Requirements of data compression, Classification. **Methods of Data Compression:** Data compression-- Loss less &Lossy

Unit V Entropy Encoding **10**

Repetitive character encoding, Run length encoding, Zero/Blank encoding; Statistical encoding -- Huffman, Arithmetic & Lempel-Ziv coding; Source encoding-- Vector quantization (Simple vector quantization & with error term); Differential encoding–Predictive coding, Differential pulse code modulation, Delta modulation, Adaptive differential pulse code modulation; Transform based coding

Discrete cosine transform & JPEG standards; Fractal compression. Recent trends in encryption and data compression techniques.

.**Total: 45 Periods**

Reference Books:

1. B. Forouzan , “Cryptography and Network Security”, McGraw-Hill.
2. Nelson , “The Data Compression Book”, BPB.
3. AtulKahate , “Cryptography & Network Security”, TMH.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE24	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Basic Research Knowledge				

Course Objectives

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

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Examine research problem formulation.	Understand
CO2.	Analyze research related information.	Analyze
CO3.	Follow research ethics.	Understand
CO4.	Utilize the Patent information and databases	Apply
CO5.	Emphasis the need of information about Intellectual Property Right to be promoted among students in general and engineering in particular	Analyze

Course Contents:

Unit I **9**

Basicis Of Research Problem: 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 **9**

Technical Writing And Proposal: 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 **9**

Intellectual Property: 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 **9**

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

Unit V **9**

Developments In IPR: 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: 45 Periods**

Reference Books:

1. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”,Juta and Company Ltd, 2nd Edition 2004.
2. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”, 2014.
3. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”, 2004.
4. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students”, 1996.
5. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
7. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008
8. Stuart Melville and Wayne Goddard, “Research methodology: anintroduction for science & engineering students”,Juta and Company Ltd,1996.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE25	DATA PREPARATION AND ANALYSIS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Data Warehousing and Data Mining				

Course Objectives

1. To understand the business environment in which data preparation occurs.
2. To study about the data cleaning techniques on real world data and prepare data for analysis
3. To perform exploratory analysis on data, such as calculating descriptive and comparative statistics
4. To learn the visualization techniques for various data analysis tasks
5. To incorporate knowledge on different mining techniques

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Work in a business environment in which data preparation occurs	Apply
CO2.	Apply data cleaning techniques on real world data and prepare data for analysis	Apply
CO3.	Perform exploratory analysis on data, such as calculating descriptive and comparative statistics	Apply
CO4.	Experiment visualization techniques for various data analysis tasks	Apply
CO5.	Illustrate different mining techniques	Apply

Course Contents:

Unit I Data Gathering and Preparation **9**

Data formats, parsing and transformation, Scalability and real-time issues

Unit II Data Cleaning **9**

Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Unit III Exploratory Analysis **9**

Descriptive and comparative statistics, Clustering and association, Hypothesis Generation

Unit IV Visualization **9**

Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

Unit V Introduction to Data mining **9**

Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods.

.**Total: 45 Periods**

Reference Books:

1. Glenn J. Myatt, “Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining”.
2. Jiawei Han and M Kamber, “Data Mining Concepts and Techniques”, Second Edition, Elsevier Publication, 2011.

3. Vipin Kumar, “Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach”, Addison Wesley, 2006.
4. G. Dong and J Pei, “Sequence Data Mining”, Springer, 2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE31	PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Networks				

Course Objectives

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

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Identify the need for performance evaluation and the metrics used for it	Understand
CO2.	Distinguish between open and closed queuing networks	Analyze
CO3.	Apply the operational laws to open and closed systems	Apply
CO4.	Use discrete-time and continuous-time Markov chains to model real world systems	Apply
CO5.	Develop analytical techniques for evaluating scheduling policies	Apply

Course Contents:

Unit I Overview Of Performance Evaluation **9**

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

Unit II Markov Chains And Simple Queues **9**

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

Unit III Multi-Server And Multi-Queue Systems **9**

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

Unit IVReal-World Workloads **9**

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

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Unit V Smart Scheduling In The M/G/1 **9**

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

.**Total: 45 Periods**

Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE32	SERVICE ORIENTED ARCHITECTURE AND DESIGN	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Web Technology				

Course Objectives

1. To learn fundamentals of XML
2. To provide an overview of Service Oriented Architecture and Web services and their importance
3. To learn web services standards and technologies
4. To learn service oriented analysis and design for developing SOA based applications
5. To Understand service modeling for application development

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Apply XML technologies	Apply
CO2.	Implement the service orientation and achieve the benefits of SOA	Apply
CO3.	Design web services and WS standards	Apply
CO4.	Use web services extensions to develop solutions	Apply
CO5.	Understand and apply service modeling, service oriented analysis and design for application development	Apply

Course Contents:

UNIT I XML **9**

XML document structure – Well-formed and valid documents – DTD – XML Schema – Parsing XML using DOM, SAX – XPath XML Transformation and XSL – Xquery

UNIT II SERVICE ORIENTED ARCHITECTURE (SOA) BASICS **9**

Characteristics of SOA, Benefits of SOA , Comparing SOA with Client-Server and Distributed architectures –-- Principles of Service Orientation – Service layers

UNIT III WEB SERVICES (WS) AND STANDARDS **8**

Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service-Level Interaction Patterns – Orchestration and Choreography

UNIT IV WEB SERVICES EXTENSIONS **8**

WS-Addressing - WS-ReliableMessaging - WS-Policy – WS-Coordination – WS -Transactions - WS-Security – Examples

UNIT V SERVICE ORIENTED ANALYSIS AND DESIGN **11**

SOA delivery strategies – Service oriented analysis – Service Modelling – Service oriented design – Standards and composition guidelines-- Service design – Business process design – Case Study

.**Total: 45 Periods**

Reference Books:

1. Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005
2. Sandeep Chatterjee and James Webber, “Developing Enterprise Web Services: An Architect's Guide”, Prentice Hall, 2004

3. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, “Java Web Services Architecture”, Elsevier, 2003.
4. Ron Schmelzer et al., “XML and Web Services”, Pearson Education, 2002.
5. Frank P.Coyle, ”XML, Web Services and the Data Revolution”, Pearson Education, 2002

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE33	COMPUTER VISION	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Graphics				

Course Objectives

1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand Hough Transform and its applications to detect lines, circles, ellipses.
4. To understand three-dimensional image analysis techniques.
5. To understand motion analysis.

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Implement fundamental image processing techniques required for computer vision	Apply
CO2.	Implement boundary tracking techniques and Perform shape analysis	Apply
CO3.	Apply Hough Transform for line, circle, and ellipse detections	Apply
CO4.	Apply 3D vision techniques	Apply
CO5.	Develop applications using computer vision techniques.	Apply

Course Contents:

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) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

Unit IV 3d Vision And Motion **9**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

.

Unit V Applications **9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians..

Total: 45 Periods

Reference Books:

1. D. L. Baggio et al., ¯Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. E. R. Davies, ¯Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, ¯Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S. Aquado, ¯Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
5. R. Szeliski, ¯Computer Vision: Algorithms and Applications‖, Springer 2011.
6. Simon J. D. Prince, ¯Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	**(60)**
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE34	BLOCKCHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites					

Course Objectives

1. To understand how blockchain systems (mainly Bitcoin and Ethereum) works
2. To securely interact with blockchain and analyze the life of blockchain
3. To incorporate the knowledge of blockchain system for sending and reading transactions.
4. To design, build, and deploy smart contracts and distributed applications
5. To integrate ideas from blockchain technology into their own projects

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand the working of blockchain systems	Understand
CO2.	Implement the network of Blockchain application	Apply
CO3.	Interact with a blockchain system by sending and reading transactions.	Apply
CO4.	Design, build, and deploy a distributed application	Apply
CO5.	Evaluate security, privacy, and efficiency of a given blockchain system	Analyze

Course Contents:

Unit I Basics **9**

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Unit II Blockchain **9**

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Unit III Distributed Consensus **9**

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Unit IV Cryptocurrency **9**

History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum --- Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

Unit V Cryptocurrency Regulation **9**

Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

Total: 45 Periods

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
3. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
4. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
5. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE35	SOFTWARE QUALITY ASSURANCE AND TESTING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Software Testing				

Course Objectives

1. To understand the basics of testing, test planning &design and test team organization
2. To study the various types of test in the life cycle of the software product.
3. To build design concepts for system testing and execution
4. To learn the software quality assurance ,metrics, defect prevention techniques
5. To learn the techniques for quality assurance and applying for applications

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Perform functional and nonfunctional tests in the life cycle of the software product. .	Apply
CO2.	Understand system testing and test execution process	Understand
CO3.	Use different system techniques	Apply
CO4.	Identify defect prevention techniques and software quality assurance metrics.	Apply
CO5.	Apply techniques of quality assurance for typical applications.	Apply

Course Contents:

Unit I Software Testing - Concepts, Issues, And Techniques **9**

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

Unit II System Testing **9**

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

Unit III System Test Categories **9**

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

Unit IVSoftware Quality **9**

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

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Unit V Software Quality Assurance **9**

Quality Assurance Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications**.**

Total: 45 Periods

Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	3				2	1	1	2	3	1	2
CO2	3	3	3	3	3				2	1	1	2	3	1	2
CO3	3	3	3	3	3				2	1	1	2	3	1	2
CO4	3	3	3	3	3				2	1	1	2	3	1	2
CO5	3	3	3	3	3				2	1	1	2	3	1	2
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination(60)**
	IAE1 (7.5)	**IAE2 (7.5)**	**IAE3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

SEMESTER III

22PEE301	Research Methodology and Intellectual Properties Rights	L	T	P	C
		3	0	0	3
Nature of Course	Professional core				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Impart knowledge and skills required for research problem formulation
2. Identify the relevant literatures for research
3. Provide skills on technical paper writing / presentation without violating professional ethics
4. Acquire knowledge on IPR and patents.
5. Gain knowledge on patent rights and Patent information database

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Identify and formulate researchproblem	Apply
CO2	Concentrate on literatures related to research problem.	Understand
CO3	Possess the ability to write a standard technical paper and presentation.	Apply
CO4	Find the correct procedure for applying patents	Apply
CO5	Become well versed on patent rights, licensing and transfer of technology.	Understand

Course Contents:

Unit- I Research Problem Formulation **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 Literature Review **9**

Effective literature studies approaches, analysis, plagiarism, and research ethics.

Unit - III TechnicalWriting /Presentation9

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, Latex Programming, a presentation and assessment by a review committee.

Unit- IV Introduction to Intellectual PropertyRights (IPR) **`9**

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

Unit-V Intellectual PropertyRights (IPR) **9**

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

Total: 45 Periods

Text Books:

1. Ahuja.V.K, "Intellectual Property Rights" Lexis Nexis Publishers 3rd Edition 2019.
2. Pandey Neeraj and DharniKhushdeep, "Intellectual Property Rights", PHIpublishers, 5th

Edition 2018.
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2nd Edition 2017.

Reference Books:

1. Niebel, "Product Design", McGraw Hill, 2nd Edition 2018.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 5th Edition 2017.
3. Mayall, "Industrial Design", McGraw Hill, 2nd Edition 2012.

Additional References:

1. https://nptel.ac.in/courses/110/105/110105139/
2. https://nptel.ac.in/courses/109/106/109106137/
3. https://nptel.ac.in/courses/109/105/109105112/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
Cos	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3												2
CO2	3													2
CO3	3							3						2
CO4	3				3									2
CO5	3					3						3		2
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examination**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse				
Evaluate				
Create				

22PCSE41	FORMAL MODELS OF SOFTWARE SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Software Engineering				

Course Objectives

The course is intended to

1. Comprehend the goals, complexity of software systems, the role of Specification activities and qualities to control complexity Assimilate the fundamentals of abstraction and formal systems
2. Incorporate fundamentals of logic reasoning- Propositional Logic, temporal logic andapply tomodelssystems
3. Comprehend formal specification models based on set theory, calculus andalgebra andapplyto acasestudy
4. Implement Z, Object Z andB Specificationlanguageswith casestudies

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Design the complexity of software systems, the need for formal specifications activities and qualities to control complexity.	Apply
CO2.	Apply knowledge on fundamentals of abstraction and formal systems	Apply
CO3.	Implement the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems	Apply
CO4.	Develop formal specification models based on set theory, calculus and algebra and apply to a typical case stud	Apply
CO5.	Use working knowledge on Z, Object Z and B Specification languages with case studies.	Apply

Course Contents:

UNIT I Specification Fundamentals 9

Introduction - Software Complexity -Integrating Formal Methods into the Software Life-Cycle Specification Qualities- Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

UNIT II Formal Methods 9

Abstraction in computing- Formal Systems –Consistency – Automata-Finite Accepters - Finite State Transducers - Extended Finite State Machine - Case Study-Elevator Control-- Specification Techniques.

UNIT III Logic 9

Propositional Logic - Natural Deduction - Predicate Logic - Policy Language Specification, knowledge Representation Axiomatic Specification - Temporal Logic -.Temporal Logic for Specification and Verification - Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).

UNIT IV Specification Models 9

Model Based Specifications-. Property Oriented Specifications- Algebraic Specification, Structured Specifications. Case Study-A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Derivation Trees, Labeled Transition Systems.

UNIT V Formal Languages 9

Z Notation - Operational Abstraction Operations Schema Decorators, Generic Functions, Proving

Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The B-Method -Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

Total: 45 Periods

Text Books:

1. M ichael Muth and Mark Ryan, "Logic in Computer Science- modeling and reasoning about systems", CambridgeUniversityPress, 2nd Edition 2019.
2. M .Ben-Ari, "MathematicalLogicforcomputerscience", Springer, 3rdEdition, 2018.

Reference Books:

1. A ntoiDiller, "Z: An Introductiontoformal methods",Wiley Publisher, 2nd Edition2019.
2. J onathanJacky , "The ways Z: Practical programming with formal methods", Cambridge UniversityPress,3rdEdition2017.
3. V .S Alagar, K.Periyasamy, David Grises and Fred Schneider "Specification of Software Systems", Springer – Verlag London, 2nd Edition 2015.

Additional References:

1. https://nptel.ac.in/courses/106/101/106101061/
2. https://nptel.ac.in/courses/106/105/106105182/
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs38/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	3	3	1								2	3	2
CO2	2	3	2	1	2								2	2	2
CO3	3	1	3	2	3								1	3	3
CO4	2	2	2	1	2								2	3	2
CO5	2	2	3	2	3								2	3	2
	3	High				2	Medium					1	Low		

Formative assessment

Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment

Bloom's Category	Continuous Assessment Tests			Terminal Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE42	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Microcontroller Programming				

Course Objectives

The course is intended to

1. Study the architecture of embedded processor, microcontroller and peripheral devices.
2. Learn the concept of memory and peripherals with embedded systems.
3. Discover the embedded network environment.
4. Identify with challenges in Real time operating systems.
5. Explore and design applications of embedded systems.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Construct assembly code for processors such as ARM, ATOM.	Apply
CO2.	Choose hardware platform and analyze platform level performance	Analyze
CO3.	Operate with embedded network environment.	Analyze
CO4.	Examine the challenges in Real time operating systems.	Analyze
CO5.	Create the various applications of embedded systems.	Create

Course Contents:

Unit - I Embedded Processors 9

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

Unit – II Embedded Computing Platform 9

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

Unit - III Embedded Network Environment 9

Distributed Embedded Architecture - Networks for Embedded Systems - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design --Allocation and Scheduling - Design Example..

Unit – IV Real-Time Characteristics 9

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

Unit - V System Design Techniques 9

Design Methodologies - Requirement Analysis – Specification System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX Ink jet printer.

Total: 45 Periods

Text Books:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, 1st edition, 2019.
2. Shibu.K.V."Introduction to Embedded Systems" McGraw Hill, 2nd Edition, 2017.

Reference Books:

1. C. M. Krishna and K. G. Shin, "Real-Time Systems", McGraw-Hill, 2nd Edition 2017.
2. Andrew N Sloss, Symes.D and Wright.C, "Arm system developer'sguide", Morgan Kauffman/Elsevier, 2nd Edition 2016.
3. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A Hands-on-Approach" Orient Blackswan Publishers, First Edition, 2015

Additional References:

1. https://nptel.ac.in/courses/108/105/108105057/
2. https://nptel.ac.in/courses/106/105/106105193/
3. https://nptel.ac.in/courses/108/102/108102045/

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3		2	2								3	1	
CO2	3	3	2										3	1	
CO3	3	2	2	2	2						1		3	1	2
CO4	3			3	3					1	1		3	1	
CO5	3		3	3									3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE43	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Nil				

Course Objectives:

The course is intended to

1. Incorporate the basic concepts and techniques of Machine Learning.
2. Study the Supervised and Unsupervised learning techniques.
3. Learn the various probabilities based learning techniques.
4. Assimilate the Advanced Techniques of Artificial Techniques Using Machine Learning techniques graphical models of machine learning algorithms.
5. Acquire the knowledge on Components Using Genetic Algorithms.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Interpreting the Basic concepts of Machine learning with types.	Understand
CO2.	Compare the solutions for Dynamic Reduction and Component analysis using Genetic Algorithms.	Analyzing
CO3.	Implement different Ways to combine Tree and Probabilistic models with Algorithms	Apply
CO4.	Examine the functions using Practical examples of MLP	Analyze
CO5.	Modify existing machine learning algorithms to improve Proposal using Artificial Neural Networks in Machine Learning.	Create

COURSE CONTENTS:

UNIT- I Introduction **9**

Learning – Types of Machine Learning – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants, Perception, Separability and Regression.

UNIT-II Dimensionality Reduction and Evolutionary Models **9**

Dimensionality Reduction techniques – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring---Genetic Operators – Using Genetic Algorithms – Reinforcement Learning.

UNIT-III Tree and Probabilistic Models **9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Statistics models.

UNIT-IV Linear Models **9**

Multi-layer Perception - Back Propagation Error – Deriving Back- Propagation – Radial Basis Functions and Splines- RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT V Artificial Neural Networks in Machine Learning and Graph Models **9**

Artificial of Neural Networks Applications-Machine Techniques Using Artificial Networks Models- Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Graphical Models – Bayesian Networks – Hidden Markov Models – Tracking Methods

TOTAL: 45 Periods

Text Books:

1. EthemAlpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", MIT Press, 3rd Edition 2019.
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2nd Edition 2017.

Reference Books:

1. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", Wiley,1st Edition 2020
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Chapman and Hall/CRC, 2nd Edition 2019.
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, 2ndEdition 2017.

Additional References:

1. https://nptel.ac.in/courses/106/106/106106139/ 5.
2. https://onlinecourses.nptel.ac.in/noc21_cs24/preview 6.
3. https://nptel.ac.in/courses/106/105/106105152/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2									1	3	1	
CO2	3	3	2									1	3	1	
CO3	3	3	2									1	3	1	
CO4	3	3	2									1	3	1	
CO5	3	3	2									1	3	1	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE44	BIO-INSPIRED COMPUTING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Fundamentals of Data Structures and Algorithms				

Course Objectives

The course is intended to

1. Incorporate bio-inspired theorem and algorithms
2. Assimilate the concept of random walk and simulated annealing
3. Implement genetic algorithm and differential evolution
4. Plan swarm optimization and ant colony for feature selection
5. Comprehend bio-inspired application in image processing

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Implement and apply bio-inspired algorithms	Apply
CO2.	Explain random walk and simulated annealing	Understand
CO3.	Implement and apply genetic algorithms	Apply
CO4.	Explain swarm intelligence and ant colony for feature selection	Understand
CO5.	Apply bio-inspired techniques in image processing	Apply

Course Contents:

Unit - I Introduction 9

Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms--- Parameter tuning and parameter control.

Unit - II Random Walk and Anealing 9

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

Unit - III Genetic Algorithms and Differential Evolution 9

Introduction to genetic algorithms and - role of genetic operators - choice of parameters--- GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients choice of parameters - convergence analysis implementation.

Unit – IV Swarm Optimization and Firefly Algorithm 9

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation---varients- Ant colony optimization toward feature selection.

Unit - V Application in Image Processing 9

Bio-Inspired Computation and its Applications in Image Processing: An Overview -- Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization -- Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat.

Total: 45 Periods

Text Books:

1. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech Publishers, Edition 2018.
2. Eiben, A.E., Smith and James E, "Introduction to Evolutionary Computing", Springer, 2nd Edition 2017.

Reference Books:

1. Yang, Cui,Xlao, Gandomi andKaramanoglu, "Swarm Intelligence and Bio-Inspired Computing", Elsevier ,1st Edition 2020.
2. Xin-She Yang and Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier ,2nd Edition 2019.
3. Xin-She Yang, "Nature Inspired Optimization Algorithm", Elsevier, 1st Edition 2019.

Additional References:

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs23/
2. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ma29/
3. https://onlinecourses.nptel.ac.in/noc20_cs17/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2									1	3	1	
CO2	3	3	2									1	3	1	
CO3	3	3	2									1	3	1	
CO4	3	3	2									1	3	1	
CO5	3	3	2									1	3	1	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE45	BIG DATA QUERY LANGUAGES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Data Warehousing and Data Mining				

Course Objectives

The course is intended to

1. To familiarize with R Programming.
2. To understand data analysis using R and HADOOP Integrated Programming Environment.
3. To Understand Analytics for Big data 'at Rest' and Real-Time Analytical Processing for Big data 'in Motion'.
4. To understand the Pig Data model and Pig scripts.
5. To learn way of Querying Big Data using Hive.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Design applications using R, HADOOP	Apply
CO2	Design applications using RHADOOP& RHIPE	Apply
CO3	Develop analytic applications for data Streams	Apply
CO4	Develop Pig scripts for Big data applications	Apply
CO5	Design Big data applications schema and use HIVE QL	Apply

Course Contents:

UNIT I INTRODUCTION TO R PROGRAMMING 9

Introduction to R – Vectors – Filtering – Matrices – Creating Matrices – Applying Functions to Matrix Rows and Columns – Lists – Creating List – General List Operations – Data Frames – Creating Data Frames – Matrix like Operations in Frames – Applying Functions to Data Frames – Factors and Tables – Math and Simulations in R – Input/Output – Reading and Writing Files – Graphics – Creating Three-Dimensional Plots – Linear Models – Non-linear models – Clustering

UNIT II DATA ANALYSIS USING R AND HADOOP 9

Features of R Language HADOOP Features – HDFS and Map Reduce architecture – R and Hadoop Integrated Programming Environment- RHIPE Introduction – Architecture of RHIPE – RHIPE function reference. RHADOOP Introduction – Architecture of RHADOOP – RHADOOP function reference, SQL on HADOOP.

UNIT III ANALYTICS FOR BIG DATA STREAMS 9

IBM Pure Data Systems – Netezza"s Design Principles – The Netezza Appliance – Extending the Netezza Analytics – Real-Time Analytical Processing – Info Sphere Streams Basics – InfoSphere Streams Working – enterprise class – industry use cases – Indexing Data from Multiple Sources – Creating Information Dashboards

UNIT IV PROGRAMMING WITH PIG 9

Introduction – installation and execution – PIG Data Model – PIG Latin – Input, Output- Relational Operators – User Defined Functions – Join Implementations – Integrating Pig with Legacy Code and Map Reduce –Developing and Testing Pig Latin Scripts – Embedding Pig Latin in Python – Evaluation Function in Java- Load Functions – Store Functions.

UNIT V PROGRAMMING WITH HIVE 9

Introduction – Data Types and File Formats – Databases in Hive – HiveQL: Data Definition – Data Manipulation – Queries – Views – Indexes – Schema Design

TOTAL: 45 Periods

Text Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Tom White " Hadoop: The Definitive Guide" Third Edition, O"reilly Media, 2011.

Reference Books:

1. Zikopoulos, P., Parasuraman, K., Deutsch, T., Giles, J., & Corrigan, D.V Harness the Power of Big Data The IBM Big Data Platform. McGraw Hill Professional, 2012.
2. Prajapati, V, "Big Data Analytics with R and Hadoop", Packt Publishing Ltd, 2013.
3. Gates, A. Programming Pig." O'Reilly Media, Inc.", 2011.

Additional References:

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
2. https://www.digimat.in/nptel/courses/video/106104189/L01.html
3. https://onlinecourses.nptel.ac.in/noc19_ma33/preview

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
Cos	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	3	3	1	2
CO2	3	3	3	3	1						1	3	3	1	2
CO3	3	3	3	3	1						1	3	3	1	2
CO4	3	3	3	3	1						1	3	3	1	2
CO5	3	3	3	3	1						1	3	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE51	DATA INTENSIVE COMPUTING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Big Data				

Course Objectives

The course is intended to

1. To understand the basics of the various database systems including databases for Big data.
2. To learn about the architecture of data intensive computing.
3. To learn about parallel processing for data intensive computing.
4. To learn about Security in Data Intensive Computing Systems.
5. To learn about the applications that involve Data intensive computing.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Design applications that involve data intensive computing.	Apply
CO2.	Analyze appropriate architecture for data intensive computing systems	Analyze
CO3.	Decide on the appropriate techniques of Map Reduce, Mongo DB, for the different Applications	Apply
CO4.	Identify parallel processing techniques for data intensive computing	Apply
CO5.	Decide on the various security techniques that are necessary for data intensive applications.	Apply

Course Contents:

UNIT I INTRODUCTION **9**

Introduction to Distributed systems – Databases Vs. File Systems--Distributed file systems(HDFS) - Distributed Machine-Learning System - Data Parallelism – Characteristics --Hadoop -Execution Engines -Map Reduce- Distributed Storage System for Structured Data – NoSQL databases - Casandra, Mongo DB-Developing a Distributed Application

UNIT II ARCHITECTURES AND SYSTEMS **9**

High performance Network Architectures for Data intensive Computing – Architecting Data Intensive Software systems – ECL/HPCC: A Unified approach to Big Data – Scalable storage for Data Intensive Computing - Computation and Storage of scientific data sets in cloud- Stream Data Model Architecture for Data Stream Management-Stream Queries -Sampling Data in a Stream Filtering Streams

UNIT III TECHNOLOGIES AND TECHNIQUES **9**

Load balancing techniques for Data Intensive computing – Resource Management for Data Intensive Clouds – SALT Parallel Processing, Multiprocessors and Virtualization in Dataintensive Computing - Challenges in Data Intensive Analysis and Visualization --Large-Scale Data Analytics Using Ensemble Clustering - Ensemble Feature Ranking Methods for Data Intensive Computing Application Record Linkage Methodology and Applications- Semantic Wrapper

UNIT IV SECURITY **9**

Security in Data Intensive Computing Systems-- Data Security and Privacy in Data-Intensive Supercomputing Clusters - Information Security in Large Scale Distributed Systems---Privacy and Security Requirements of Data Intensive Applications in Clouds

UNIT V APPLICATIONS AND FUTURE TRENDS **9**

Cloud and Grid Computing for Data Intensive Applications -Scientific Applications --Bioinformatics Large Science Discoveries - Climate Change - Environment - Energy - Commercial Applications - Future trends in Data Intensive Computing

Total: 45 Periods

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media. October 2010.
2. Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom., "Database Systems: The Complete Book", Pearson, 2013.

Reference Book:

1. Furht, Borko, Escalante, Armando, "Handbook of Data Intensive Computing", Springer 2011.
2. Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed computing: principles, algorithms, and systems. Cambridge University Press, 2011.
3. George Coulouris, Jean Dollimore and Tim Kindberg, ¯Distributed Systems Concepts and Design‖, Fifth Edition, Pearson Education, 2012.

Additional References:

1. https://www.youtube.com/watch?v=zs6Add_-BKY
2. http://www.nitttrc.edu.in/nptel/courses/video/106104182/lec1.pdf
3. https://www.youtube.com/watch?v=A3FPxuKlnkU

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
Cos	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3		3	2	2								3	1	
CO2	3	3	2	2									3	1	
CO3	3	2		3									3	1	2
CO4	3	2		3	2								3	1	2
CO5	3		3	2									3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE52	RECONFIGURABLE COMPUTING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Learn the various device architectures
2. Pointoutthesalientfeaturesofdifferentreconfigurablearchitectures.
3. Discover the basic modules using any HDL.
4. Discuss the mapping designs for reconfigurable platform.
5. Study the concepts of FPGA and SoPC application.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Identify the need for reconfigurable architecture	Understand
CO2.	Examine the salient features of different reconfigurable architectures.	Analyze
CO3.	Implement the different types of computer models for programming reconfigurable architectures	Apply
CO4.	Develop the mapping designs for reconfigurable platform.	Apply
CO5.	Design and build an FPGA and SoPC application.	Create

COURSE CONTENTS:

UNITI Device Architecture **9**

GeneralPurposeComputingVsReconfigurableComputing-SimpleProgrammableLogicDevices-ComplexProgrammableLogicDevices-FPGAs-DeviceArchitecture – CaseStudies.

UNITII Reconfigurable ComputingArchitectures and Systems **9**

ReconfigurableProcessingFabricArchitectures-RPFIntegrationintoTraditionalComputingSystems-ReconfigurableComputingSystems-CaseStudies -ReconfigurationManagement

UNITIII Programming Reconfigurable Systems **9**

ComputeModels-ProgrammingFPGAApplicationsinHDL-CompilingCforSpatialComputing-Operating SystemSupportforReconfigurableComputing

UNITIV Mapping Designs to Reconfigurable Platforms **9**

TheDesignFlow-TechnologyMapping-FPGAPlacementandRouting-ConfigurationBit streamGeneration-Case Studieswith AppropriateTools.

UNITV Application Developmentwith FPGAS **9**

CaseStudiesof FPGAApplications SystemonaProgrammableChip(SoPC)Designs.

TOTAL: 45PERIODS

Text Books:

1. ChristopheBobda, “IntroductiontoReconfigurableComputing-Architectures,Algorithms andApplications”, Springer, 5th Edition 2020.
2. MayaGokhale.BandPaulS.Graham, “Reconfigurable Computing: Accelerating ComputationwithField-ProgrammableGateArrays”, Springer,3rd Edition 2018.

Reference Books:

1. Scott Hauck and AndreDehon,”Reconfigurable Computing- The Theory and Practice of FPGA-Based computation”, Elsevier / Morgan Kaufmann, 5th Edition 2020.

2. Joaocardoso and Michael Hubne "Reconfigurable Computing: From FPGA s to Hardware /Software Code design", Springer, 2nd Edition 2019.
3. Nicole Hemsoth and Timothy Prickett Morgan "FPGA Frontiers: New Applications in Reconfigurable Computing", Tata McGraw Hill, edition 2018.

Additional References:

1. https://www.coursera.org/lecture/fpga-intro/fpga-configuration-an-overview-KwCvM
2. https://www.youtube.com/watch?v=5_H_j72Ftq8
3. https://nptel.ac.in/courses/117/108/117108040/

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2									1	3	1	
CO2	3	3	2									1	3	1	
CO3	3	3	2									1	3	1	
CO4	3	3	2									1	3	1	
CO5	3	3	2									1	3	1	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE53	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Mathematical and Logical Knowledge				

Course Objectives

The course is intended to

1. Assimilate system requirements for mobile applications.
2. Generate suitable design using specific mobile development frameworks.
3. Generate mobile application design.
4. Implement the design using specific mobile development frameworks.
5. Deploy the mobile applications in marketplace for distribution.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Describe the requirements for mobile applications.	Understand
CO2	Explain the challenges in mobile application design and development.	Understand
CO3	Develop design for mobile applications for specific requirements.	Apply
CO4	Design application using Android SDK.	Create
CO5	Design application using Objective C and iOS. And Deploy mobile applications in Android and iPhone marketplace for distribution	Create

Course Contents:

UNIT I Introduction **5**

Introduction to mobile applications – Embedded systems Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications

UNIT II Basic Design **8**

Basics of embedded systems design – Embedded OS Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints.

UNIT III Advanced Design **8**

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications

UNIT IV Android **12**

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V IoS **12**

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

TOTAL: 45 Periods

Text Books:

1. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, Dream Tech,5th Edition 2020.
2. James Dovey and Ash Furrow, “Beginning Objective C”Apress, 2nd Edition 2018.

3. David Mark, Jack Nutting, JeffLaMarche and Frederic Olsson, “Beginning iOS 6 Development: Exploring the iOS SDK”, Apress, 3rd Edition 2017.

Reference Books:

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development”, Wrox, 2nd Edition2019.
2. Reto Meier, “Professional android Development”, Wiley-India,Edition 2017.

Additional References:

1. https://nptel.ac.in/courses/106/106/106106156/
2. https://nptel.ac.in/courses/106/106/106106222/
3. http://developer.android.com/develop/index.html.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
	Pos												**PSOs**		
Cos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	1						1	3	3	1	2
CO2	3	3	3	3	1						1	3	3	1	2
CO3	3	3	3	3	1						1	3	3	1	2
CO4	3	3	3	3	1						1	3	3	1	2
CO5	3	3	3	3	1						1	3	3	1	2
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE54	BIOINFORMATICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Nil				

Course Objectives

The course is intended to

1. Exposed to the need for Bioinformatics technologies.
2. Implement with the modeling techniques.
3. Apply pattern matching techniques to bioinformatics data – protein data genomic data.
4. Exposed to Pattern Matching and Visualization.
5. Incorporate using microarray analysis for genomic expression.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1.	Demonstrate with the requirements for formation of systems	Understand
CO2.	Inspect the basic structural and functional elements of human body	Understand
CO3.	Knowledge on pattern matching techniques to bioinformatics data	Apply
CO4.	Develop models for biological data	Understand
CO5.	Apply micro array technology for genomic expression study	Apply

Course Contents:

Unit - I Biological Data Acquisition 9

The form of biological information. Retrieval methods for DNA sequence, protein sequence and protein structure information.

Unit - II Databases 9

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases---primary sequence databases, protein sequence and structure databases, Organism specific databases.

Unit - III Data Processing 9

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local versus global. Distance metrics. Similarity and homology. Scoring matrices.

Unit – IV Methods of Analysis 9

Dynamic programming algorithms, Needleman-wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA, and PSI BLAST. Multiple Sequence Alignment and software tools for pairwise and multiple sequence alignment.

Unit - V Applications 9

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis : Comparative genomics, orthologs, paralogs. Genome analysis – Genome annotation.

Total: 45 Periods

Text Books:

1. BehrouzA.Forouzan, “Data Communication and networking”, Tata Mc-Graw Hill, 2nd Edition 2017.
2. Govindrajalu.B, “IBM PC and Clones Hardware Troubleshooting and Maintenance”, Tata McGraw hill Publishers,5th Edition 2015.

Reference Books:

1. Arthur K. Lesk,” Introduction to Bioinformatics”, Oxford University Press,2nd Edition 2020.

2. Yi-Ping Phoebe Chen (Ed), "Bio Informatics Technologies", Springer Verlag, 5th Edition 2019.
3. David W. Mount, "Bioinformatics Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press,2nd Edition 2017.

Additional References:

1. https://nptel.ac.in/courses/102/106/102106065/
2. https://onlinecourses.nptel.ac.in/noc21_bt06/preview
3. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-bt01/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2									1	3	1	
CO2	3	3	2									1	3	1	
CO3	3	3	2									1	3	1	
CO4	3	3	2									1	3	1	
CO5	3	3	2									1	3	1	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Terminal Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	20
Understand	20	20	20	50
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PCSE55	INFORMATION STORAGE AND MANAGEMENT	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	operating system				

Course Objectives

The course is intended to

1. Comprehend the concept of storage architecture and available technologies.
2. Identify components of managing and monitoring the data center.
3. Define information security and identify different storage virtualization technologies
4. Examine the business impact analysis and data replications.
5. Evaluate information security requirements and recommend solutions

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1.	Selectfromvariousstoragetechnologiestosuitforrequiredapplication	Analyze
CO2.	Applysecuritymeasurestosafeguardstorage&farm	Apply
CO3.	Evaluate storage architectures, DAS, SAN, NAS, and CAS	Evaluate
CO4.	Apply theory and principles to diverse information contexts	Apply
CO5.	Analyze the storage infrastructure and management activities	Analyze

Course Contents:

UNIT I Introduction to Information Storage Technology 9

Review data creation and the amount of data being created and understand the value of data to a business, Challenges in Data Storage and Management, Data Storage Infrastructure. Storage Systems Environment: Components of a Storage System Environment.

UNIT II Data Protection 9

Concept of RAID and its Components, Intelligent Storage Systems: Components, Intelligent Storage Array, High-level architecture and working of an intelligent storage system, Case study- Demonstrating Various RAID Model

UNIT III Introduction to Networked Storage 9

Evolution of networked storage, Architecture, Overview of FC-SAN, NAS, and IP-SAN. NAS, File Sharing, I/O operations, Performance and Availability. CAS - Storage and Retrieval- Examples,Storage Virtualization: Forms- Taxonomy- Configuration- Challenge.

UNIT IV Information Availability, Managing & Monitoring 9

Information Availability, Business continuity, Failure Analysis, Business impact Analysis, Disaster Recovery: Backup, Methods and Technologies, Replication technologies: Local replicas, Technologies, Restore and Restart, Multiple Replicas. Remote Replication. DR in practice.

UNIT V Storage Security and Management 9

Security Framework, Storage security domains, List and analyzes the common threats in each domain, Security Implementations. Managing The Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Management Activities.

Total: 45 Periods

Text Books:

1. Marc Farley, “Building Storage Networks”, Tata McGraw Hill, Osborne,2nd Edition 2019.
2. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 5th Edition 2017.

Reference Books:

1. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 4th Edition 2020.
2. SomasundaramGnanaSundaramAlokShrivastava,"Information Storage and Management", Wiley Publishers, 2nd Edition 2019.
3. Meeta Gupta, "Storage Area Networks Fundamentals", Pearson Education Limited, 2nd Edition 2018.

Additional References:

1. https://nptel.ac.in/courses/106/106/106106157/
2. http://www.digimat.in/nptel/courses/video/106108058/L06.html
3. https://nptel.ac.in/courses/106/105/106105175/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

	Pos												PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3		3		2			1			2		2	2
CO2	3	3	2	3	3	2			2	1		3	3	2	2
CO3	3	3	2	3	3	1			2			3	3	2	3
CO4	3	3	2	3	3	1			2		3	2	3	2	2
CO5	3	2	1	3					1		3	2	3	2	2
	3	High				2	Medium					1	Low		

Formative assessment

Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment

Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE – I (7.5)	**IAE – II (7.5)**	**IAE – III (10)**	
Remember	10	10	10	30
Understand	20	20	20	40
Apply	20	20	20	30
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0