M.E. Computer Science and Engineering

Curriculum &

Syllabus - R2020

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 2020
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)									
20PMA103	Applied Probability and Statistics	FC	3	2	0	4	40	60	100
20PCS101	Mobile and Pervasive Computing	PC	3	0	0	3	40	60	100
20PCS102	Applied Cryptography	PC	3	0	0	3	40	60	100
20PCS103	Advanced Data Structures and Algorithms	PC	3	2	0	4	40	60	100
20PCSEXX	Professional Elective I	PE	3	0	0	3	40	60	100
20PCSEXX	Professional Elective II	PE	3	0	0	3	40	60	100
Practical Course									
20PCS104	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)									
20PCS201	Advanced Operating Systems	PC	3	0	0	3	40	60	100
20PCS202	Internet of Things	PC	3	0	0	3	40	60	100
20PCS203	Cloud Computing	PC	3	0	0	3	40	60	100
20PCS204	Big Data Analytics	PC	3	0	0	3	40	60	100
20PCSEXX	Professional Elective III	PE	3	0	0	3	40	60	100
20PCSEXX	Professional Elective IV	PE	3	0	0	3	40	60	100
Practical Course									
20PCS205	Data Analytics Laboratory	PC	0	0	4	2	50	50	100
Employability Enhancement Course									
20PCS206	Technical Seminar and Internship	EEC	0	0	2	1	50	50	100
Total			**18**	**0**	**6**	**21**	**340**	**460**	**800**

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III SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
20PEE301	Research Methodology and Intellectual Property Rights	PC	3	0	0	3	40	60	100
20PCSEXX	Professional Elective V	PE	3	0	0	3	40	60	100
20PCSEXX	Professional Elective VI	PE	3	0	0	3	40	60	100
Employability Enhancement Course									
20PCS301	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									
20PCS401	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

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Electives – I									
Code No	Course	Category	Periods/Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20PCSE01	Advanced Computer Architecture	PE	3	0	0	3	40	60	100
20PCSE02	Advanced Database Technology	PE	3	0	0	3	40	60	100
20PCSE03	Advanced computer networks	PE	3	0	0	3	40	60	100
20PCSE04	Real time systems	PE	3	0	0	3	40	60	100
20PCSE05	Open Source Systems	PE	3	0	0	3	40	60	100

Electives – II									
Code No	Course	Category	Periods/Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20PCSE11	Soft Computing	PE	3	0	0	3	40	60	100
20PCSE12	Information Retrieval Techniques	PE	3	0	0	3	40	60	100
20PCSE13	Wireless Sensor Networks	PE	3	0	0	3	40	60	100
20PCSE14	Parallel Programming Paradigms	PE	3	0	0	3	40	60	100
20PCSE15	Compiler Optimization Techniques	PE	3	0	0	3	40	60	100

Electives – III									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20PCSE21	Software Architectures And Design	PE	3	0	0	3	40	60	100
20PCSE22	Ethical Hacking	PE	3	0	0	3	40	60	100
20PCSE23	Network Security	PE	3	0	0	3	40	60	100
20PCSE24	Intellectual Property Rights	PE	3	0	0	3	40	60	100
20PCSE25	Social Network Analysis	PE	3	0	0	3	40	60	100

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Electives – IV									
Code No.	Course	Category	Periods /Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20PCSE31	Performance Analysis of Computer Systems	PE	3	0	0	3	40	60	100
20PCSE32	Language Technologies	PE	3	0	0	3	40	60	100
20PCSE33	Computer Vision	PE	3	0	0	3	40	60	100
20PCSE34	Speech Processing and Synthesis	PE	3	0	0	3	40	60	100
20PCSE35	Software Quality Assurance and Testing	PE	3	0	0	3	40	60	100

Electives – V									
Code No.	Course	Category	Periods/Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20PCSE41	Formal models of software Systems	PE	3	0	0	3	40	60	100
20PCSE42	Embedded Software Development	PE	3	0	0	3	40	60	100
20PCSE43	Machine Learning Techniques	PE	3	0	0	3	40	60	100
20PCSE44	Bio-inspired Computing	PE	3	0	0	3	40	60	100
20PCSE45	High-speed networks	PE	3	0	0	3	40	60	100

Electives – VI									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
20PCSE51	Data Visualization Techniques	PE	3	0	0	3	40	60	100
20PCSE52	Reconfigurable Computing	PE	3	0	0	3	40	60	100
20PCSE53	Mobile Application Development	PE	3	0	0	3	40	60	100
20PCSE54	Bio Informatics	PE	3	0	0	3	40	60	100
20PCSE55	Information Storage Management	PE	3	0	0	3	40	60	100

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20PMA103	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

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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

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20PCS101	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Mobile Computing				

Course Objectives

1. To learn the basic architecture and concepts till Third Generation Communication systems
2. To understand the latest 4G Telecommunication System Principles
3. To introduce the broad perspective of pervasive concepts and management
4. To explore the HCI concepts in Pervasive environment
5. To 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.	Obtain a thorough understanding of basic architecture and concepts of till Third Generation Communication systems	Understand
CO2.	Explain the latest 4G Telecommunication System Principles	Understand
CO3.	Incorporate the pervasive concepts	Apply
CO4.	Implement the HCI in Pervasive environment	Apply
CO5.	Work on the pervasive concepts in mobile environment	Analyze

Course Contents:

Unit I Introduction 9

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

Unit II Overview of a Modern 4G Telecommunications System 9

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

Unit III Pervasive Concepts and Elements 9

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

Unit IV HCI in Pervasive Computing 9

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

Unit V Pervasive Mobile Transactions 9

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

Total: 45 Periods

Reference Books:

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, "Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications", Springer, 2016
2. J.Schiller, "Mobile Communication", Addison Wesley, 2000.
3. Juha Korhonen, "Introduction to 4G Mobile Communications", Artech House Publishers, 2014.

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 (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

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20PCS102	APPLIED CRYPTOGRAPHY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Computer Networks and Number Theory				

Course Objectives

1. To analyze the concepts of cryptographic techniques
2. To apply the mathematical representation of cryptographic algorithms
3. To implement the symmetric and asymmetric encryption algorithms

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Analyze the taxonomy of cryptography primitives	Analyze
CO2.	Apply the mathematical concepts in cryptography	Apply
CO3.	Analyze the usage of random number generators in Encryption and Decryption	Analyze
CO4.	Apply the Symmetric key and public key encryption techniques	Apply
CO5.	Develop Hash algorithms to ensure the authentication	Create

Course Contents:

Unit I Introduction 9

Cryptography goals -Taxonomy of cryptography primitives -Background on functions -Basic terminology - Block ciphers, stream cipher, substitution ciphers, transposition ciphers -Composition of ciphers –Digital signature -Public key cryptography -Hash functions -Protocol and mechanism - Key establishment and management -Pseudo random numbers -Classes of attack

Unit II Number Theory 9

Probability theory -Information theory- Entropy, Mutual Information- -Complexity theory –Number theory -Abstract algebra -Finite fields -Primality test -Prime number generation -Irreducible polynomial.

Unit III Random Generators 9

Pseudo random bits and sequences -Random bit generation -Pseudorandom bit generation -ANSI x9.17 Generator -FIPS 186 Generator- statistical tests -Cryptographically secure pseudorandom bit generation - RSA pseudorandom bit generator - Blum-Blum-Shub pseudorandom bit generator.

Unit IV Encryption Algorithms 9

Block cipher -DES -Product ciphers and Feistel ciphers - DES algorithm- DES properties and strength- FEAL -IDEA -SAFER -Public key encryption -RSA public key encryption- Description - Security of RSA- RSA encryption in practice -Rabin -Elgamal -Mc Eliece -Knapsack.

Unit V Hash Algorithms 9

Hash function and data integrity -Classification and framework -Basic constructions and general results - Un keyed hash functions -Keyed hash functions -data integrity and message authentication –Advanced attacks and hash function.

Total: 45 Periods

Reference Books:

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1. A.Menezes, P.Van Oorschot and S. Vanstone, "Hand book of Applied Cryptography", CRC Press, Fifth Printing, 2001.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security, Private communication in public world", PHI 2nd edition 2002.
3. Bruce Schneier, Neils Ferguson, "Practical Cryptography", Wiley Dreamtech India Pvt Ltd, 2003
4. Douglas R Simson, "Cryptography -Theory and practice", CRC Press 1995.
5. Stallings, "Cryptography & Network Security", Pearson Education, 4th Edition 2006.

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

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20PCS103	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

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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

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20PCS104	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

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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		

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20PCS201	ADVANCED OPERATING SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Operating systems				

Course Objectives

1. To be able to read and understand sample open source programs and header files.
2. To learn how the processes are implemented in linux.
3. To understand the implementation of the Linux file system.
4. To study Linux memory management data structures and algorithms.
5. To acquire the knowledge in the implementation of interprocess communication.

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	To explain the functionality of a large software system by reading its source.	Understand
CO2.	To work on Linux memory management data structures and algorithms	Apply
CO3.	To revise any algorithm present in a system.	Analyze
CO4.	To design a new algorithm to replace an existing one.	Apply
CO5.	To appropriately modify and use the data structures of the linux kernel for a different software system	Apply

Course Contents:

Unit I Introduction **9**

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes - Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

Unit II Processes **9**

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - - System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

Unit III File System **9**

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Filesystems - Filesytem Type Registration - Filesytem Handling - Namespaces - Mounting - Unmounting - Implementation of VFS System Calls.

Unit IV Memory Management **9**

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

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Unit V Process Communication and Program Execution 9

Process Communication - Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command-Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions

Total: 45 Periods

Reference Books:

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, —Structure and Interpretation of Computer Programsll, Second Edition, Universities Press, 2013.
3. Maurice J. Bach, —The Design of the Unix Operating Systemll 1st Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, —Linux Kernel Internalsll, 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, —Linux Kernel Developmentll, 3rd Edition, Addison-Wesley, 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	3	1	2
CO2	3	3	3	3	3					2	1	1	3	1	2
CO3	3	3	3	3	3					2	1	1	3	1	2
CO4	3	3	3	3	3					2	1	1	3	1	2
CO5	3	3	3	3	3					2	1	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(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

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20PCS202	INTERNET OF THINGS	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 basic architecture and concepts till Third Generation Communication systems.
2. To understand the latest 4G Telecommunication System Principles.
3. To introduce the broad perspective of pervasive concepts and management
4. To explore the HCI in Pervasive environment
5. To 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 I Introduction to IoT 9

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

Unit II IoT Architecture 9

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

Unit III IoT Protocols 9

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

Unit IV Building IoT with Raspberry Pi & Arduino 9

Building IOT with 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:

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

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20PCS203	CLOUD COMPUTING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Distributed Systems				

Course Objectives

1. To understand the concepts of virtualization and virtual machines
2. To gain expertise in server, network and storage virtualization.
3. To understand and deploy practical virtualization solutions and enterprise solutions
4. To gain knowledge on the concept of virtualization that is fundamental to cloud computing
5. To understand the various issues in cloud computing
6. To be able to set up a private cloud
7. To understand the security issues in the grid and 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	Analyze

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 IV Programming Model 9

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

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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 Guidell, 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, Subra Kumaraswamy, and Shahed Latif ,"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

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20PCS204	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Data Mining				

Course Objectives

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 IV Mining 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

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Reference Books:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analyticsll, 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 Analysisll, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "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

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20PCS205	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 to

1. To implement Map Reduce programs for processing big data
2. To realize storage of big data using H base, Mongo DB
3. To analyze big data using linear models
4. To analyze big data using machine learning techniques such as SVM / Decision tree classification and clustering

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

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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		

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20PCS206	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		

20PCSE01	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C

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		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Architecture				

Course Objectives

1. 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:

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - ACADEMIC COUNCIL

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 Approachll", Morgan Kaufmann / Elsevier, 5th edition, 2012
3. Kai Hwang and Zhi.Wei Xu, "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

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20PCSE02	ADVANCED DATABASE TECHNOLOGY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Database systems				

Course Objectives

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

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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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

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20PCSE03	ADVANCED COMPUTER NETWORKS	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 principles required for network design
2. To explore various technologies in the wireless domain
3. To study about 3G and 4G cellular networks
4. To understand the paradigm of Software defined networks

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Identify the components required for designing a network .	Understand
CO2.	Examine the relational database system design	Analyze
CO3.	Design a network at a high-level using different networking technologies .	Apply
CO4.	Analyze the various protocols of wireless and cellular networks	Analyze
CO5.	Experiment the features of 4G and 5G networks .	Apply

Course Contents:

Unit I Network Design 9

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

Unit II Wireless Networks 9

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

Unit III Cellular Networks 9

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

Unit IV 4G Networks 9

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

Unit V Software Design Networks 9

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

Total: 45 Periods

Reference Books:

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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1. Erik Dahlman, Stefan Parkvall, Johan Skold, "4G: LTE/LTE-Advanced for Mobile Broadband", Academic Press, 2013.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
3. Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", 5th edition, Morgan Kauffman, 2011
4. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.
5. Martin Sauter, "Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0", Wiley, 2009.
6. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, "Next-Generation Wireless Technologies", Springer, 2013.
7. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kauffman, 2014.
8. Savo G Glisic, "Advanced Wireless Networks – 4G Technologies", John Wiley & Sons, 2007.
9. Thomas D.Nadeau and Ken Gray, "SDN – Software Defined Networks", O"Reilly Publishers, 2013.
10. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 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

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20PCSE04	REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Architecture				

Course Objectives

1. To learn real time operating system concepts, the associated issues & Techniques.
2. To understand design and synchronization problems in Real Time System.
3. To explore the concepts of real time databases.
4. To understand 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 collection – contiguous file systems.

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

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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Reference Books:

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

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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20PCSE05	OPEN SOURCE SYSTEMS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Operating Systems				

Course Objectives

1. Understand the difference between open source software and commercial software.
2. Familiarity with Linux operating system.
3. Understanding and development of web applications using open source web technologies like Apache, MySql and PHP (LAMP/XAMP).

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand the difference between open source software and commercial software	Understand
CO2.	Identify, install and run Linux operating system.	Apply
CO3.	Install and manage applications	Apply
CO4.	Identify, install open source web technologies Apache, MySql, PHP.	Apply
CO5.	Develop web applications using LAMP	Apply

Course Contents:

Unit I OPEN SOURCE **9**

Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Where I can use Linux? Linux Kernel – Linux Distributions

Unit II LINUX **9**

Introduction to Linux Essential Commands - Filesystem Concept - Standard Files 1. The Linux Security Model - Vi Editor - Partitions creation - Shell Introduction 2. String Processing - Investigating and Managing Processes - Network Clients - Installing Application

Unit III APACHE **9**

Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess

Unit IV MYSQL **9**

Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database

Unit V PHP **9**

Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code - Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

Total: 45 Periods

Reference Books:

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

CHAIRMAN - BOARD OF STUDIES

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1. James Lee and Brent Ware ,"Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", , Dorling Kindersley(India) Pvt. Ltd, 2008.
2. Eric Rosebrock, Eric Filson ,"Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together", Published by John Wiley and Sons, 2004. .

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

20PCSE11	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:

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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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

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20PCSE12	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

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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Reference Books:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, —Introduction to Information Retrievall, Cambridge University Press, First South Asian Edition, 2008.
2. Implementing and Evaluating Search Enginesll, The MIT Press, Cambridge, Massachusetts London, England, 2010
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, —Modern Information Retrieval: The concepts and Technology behind Searchll (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

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20PCSE13	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Computer Networks				

Course Objectives

1. Architect sensor networks for various application setups
2. Devise appropriate data dissemination protocols and model links cost
3. Understanding the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers
4. Evaluate the performance of sensor networks and identify bottlenecks

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand the fundamental concepts of wireless Sensor Networks and its architecture	Understand
CO2.	Illustrate the operations of Network Simulator-3	Analyze
CO3.	Apply Discrete time Markov Chain and describe MAC Protocol design	Apply
CO4.	Evaluate the varies attacks and Static and Dynamic Key Distribution	Evaluate
CO5.	Describe the MANET protocols and Software applications	Analyze

Course Contents:

Unit I Introduction to Wireless Sensor Networks **9**

Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture Hardware Platforms: Motes, Hardware parameters

Unit II Introduction to ns-3 **9**

Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

Unit III Medium Access Control Protocol design **10**

Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled - Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis - MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis(Markov Chain)

Unit IV Security **8**

Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.

Unit V Routing Protocols **9**

Introduction, MANET protocols - Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast - Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks. Advanced topics Recent development in WSN standards, software applications.

.Total: 45 Periods

Reference Books:

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1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks -Technology, Protocols, and Applications", Wiley Interscience 2007
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 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

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20PCSE14	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 With Pthreads **9**

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

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

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

Unit V **9**

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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 OpenMPI, Tata McGraw Hill, 2003.
2. A.Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, —OpenCL programming guidell, Addison Wesley, 2011
3. Peter S. Pacheco, —An introduction to parallel programmingll, Morgan Kaufmann, 2011.
4. Rob Farber, —CUDA application design and developmentll, Morgan Haufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, —Using MPI: Portable parallel programming with the message passing interfacell, 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
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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

20PCSE15	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C

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		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Compiler design				

Course Objectives

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

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Identify the different optimization techniques for simple program blocks.	Understand
CO2.	Design performance enhancing optimization techniques.	Apply
CO3.	Apply Procedure Optimization And Scheduling	Apply
CO4.	Perform the optimization on procedures.	Apply
CO5.	Ensure better utilization of resources.	Analyze

Course Contents:

Unit I Intermediate Representations And Analysis 9

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

Unit II Early And Loop Optimization 9

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

Unit III Procedure Optimization And Scheduling 9

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

Unit IV Inter Procedural Optimization 9

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

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Unit V Register Allocation And Optimizing For Memory **9**

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

.Total: 45 Periods

Reference Books:

1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.
2. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.
3. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011. 5. Randy Allen and Ken Kennedy, —Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufman, 2001.
4. Robert Morgan ,‖Building an Optimizing Compiler‖, Digital Press, 1998
5. Steven Muchnick, —Advanced Compiler Design and Implementation‖, Morgan Kaufman Publishers, 1997.

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

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20PCSE21	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.

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 I Introduction 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 IV Architecture 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

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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

20PCSE22	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

Introduction to Ethical Disclosure: Ethics of Ethical Hacking, Ethical Hacking and the legal system, Proper and Ethical Disclosure **9**

Unit II

Penetration Testing and Tools: Using Metasploit, Using BackTrackLiveCD Linux Distribution **9**

Unit III

Vulnerability Analysis: Passive Analysis, Advanced Static Analysis with IDA Pro, Advanced Reverse Engineering **9**

Unit IV

Client-side Browser Exploits: Exploiting Windows Access Control Model for Local Elevation Privilege, Intelligent Fuzzing with Sulley, From Vulnerability to Exploit. **9**

Unit V

Malware Analysis: Collecting Malware and Initial Analysis, Hacking Malware **Case Study:** Case study of vulnerability of cloud platforms and mobile platforms & devices. **9**

.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.

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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

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20PCSE23	NETWORK SECURITY	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of CNS				

Course Objectives

1. To understand various security measures
2. To learn the threats and securities of a system
3. To study the security policies and procedures
4. To plan the security on various situations
5. To know about operations of security

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Understand basics of security	Understand
CO2.	Analyze the various threats and vulnerabilities of system	Analyze
CO3.	Know on various security plannings	Understand
CO4.	Apply various security policies and procedures	Apply
CO5.	Describe the use of Operations Security(OPSEC)	Analyze

Course Contents:

Unit I 9

Security basics: Information Security (INFOSEC) Overview: critical information characteristics – availability information states – processing security countermeasures_education, training and awareness, critical information characteristics – confidentiality critical information characteristics – integrity, information states – storage, information states – transmission, security countermeasures_policy, procedures and practices, threats, vulnerabilities.

Unit II 9

Threats to and Vulnerabilities of Systems: Definition of terms (e.g., threats, vulnerabilities, risk), major categories of threats (e.g., fraud, Hostile Intelligence Service (HOIS), malicious logic, hackers, environmental and technological hazards, disgruntled employees, careless employees, HUMINT, and monitoring), threat impact areas, Countermeasures assessments (e.g., surveys, inspections), Concepts of Risk Management: consequences (e.g., corrective action, risk assessment), cost/benefit analysis of controls, implementation of cost_effective controls, monitoring the efficiency and effectiveness of controls (e.g., unauthorized or inadvertent disclosure of information), threat and vulnerability assessment

Unit III 9

Security Planning: Directives and procedures for policy mechanism, Risk Management: acceptance of risk (accreditation), corrective actions information identification, risk analysis and/or vulnerability assessment components, risk analysis results evaluation, roles and responsibilities of all the players in the risk analysis process, Contingency Planning/Disaster Recovery: agency response procedures and continuity of operations, contingency plan components, determination of backup requirements, development of plans for recovery actions after a disruptive event, development of procedures for off_site processing, emergency destruction procedures, guidelines for determining critical and essential workload, team member responsibilities in responding to an emergency situation

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Unit IV **9**

Policies and procedures: Physical Security Measures: alarms, building construction, cabling, communications centre, environmental controls (humidity and air conditioning), filtered power, physical access control systems (key cards, locks and alarms) Personnel Security Practices and Procedures: access authorization/verification (need_to_know), contractors, employee clearances, position sensitivity, security training and awareness, systems maintenance personnel, Administrative Security Procedural Controls: attribution, copyright protection and licensing , Auditing and Monitoring: conducting security reviews, effectiveness of security programs, investigation of security breaches, privacy review of accountability controls, review of audit trails and logs

Unit V **9**

Operations Security (OPSEC): OPSEC surveys/OPSEC planning INFOSEC: computer security – audit, cryptography_encryption (e.g., point_to_point, network, link), cryptography_key management (to include electronic key), cryptography_strength (e.g., complexity, secrecy, characteristics of the key) Case study of threat and vulnerability assessment

.Total: 45 Periods

Reference Books:

1. Principles of Incident Response and Disaster Recovery, Whitman & Mattord, Course Technology ISBN: 141883663X
2. (Web Link) http://www.cnss.gov/Assets/pdf/nstissi_4011.pdf

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
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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
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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

20PCSE24	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

Bascis 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:

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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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

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20PCSE25	SOCIAL NETWORK ANALYSIS	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 components of the social network.
2. To model and visualize the social network.
3. To mine the users in the social network.
4. To understand the evolution of the social network.
5. To know the applications in real time systems.

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Work on the internals components of the social network	Understand
CO2.	Model and visualize the social network	Apply
CO3.	Mine the behaviour of the users in the social network	Analyze
CO4.	Predict the possible next outcome of the social network	Analyze
CO5.	Apply social network in real time applications	Apply

Course Contents:

Unit I 9

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

Unit II 9

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

Unit III 9

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

Unit IV 9

Evolution: Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

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Unit V 9

Application: A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

.Total: 45 Periods

Reference Books:

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

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
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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

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20PCSE31	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**

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

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

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

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

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

Unit IV Real-World Workloads **9**

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

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

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

.Total: 45 Periods

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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. Lieven Eeckhout, —Computer Architecture Performance Evaluation Methods‖, Morgan and Claypool Publishers, 2010.
4. Mor Harchol - 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		
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CO1	3	3	3	3	3				2	1	1	2	3	1	2
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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

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20PCSE32	LANGUAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Programming Languages				

Course Objectives

1. To learn the fundamentals of natural language processing
2. To appreciate the use of CFG and PCFG in NLP
3. To understand the role of semantics and pragmatics

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	To tag a given text with basic Language features	Understand
CO2.	To design an innovative application using NLP components	Apply
CO3.	To implement a rule based system to tackle morphology/syntax of a language	Apply
CO4.	To design a tag set to be used for statistical processing for real-time applications	Apply
CO5.	To 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.

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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

20PCSE33	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

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Reference Books:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	POs												PSOs		
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Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
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Summative Assessment				
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Apply	30	30	30	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

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20PCSE34	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Fundamentals of Programming Languages				

Course Objectives

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

Course Outcomes

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

CO.No.	Course Outcome	Bloom's Level
CO1.	Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word	Understand
CO2.	Determine and apply Mel-frequency cepstral coefficients for processing all types of signals	Apply
CO3.	Justify the use of formant and concatenative approaches to speech synthesis	Analyze
CO4.	Apply the apt approach of speech synthesis depending on the language to be processed	Apply
CO5.	Develop the various encoding techniques for representing speech.	Apply

Course Contents:

Unit I Fundamentals of Speech Processing 9

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

Unit II Speech Signal Representations and Coding 9

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

Unit III Speech Recognition 9

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

Unit IV Text Analysis 9

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

.

Unit V Speech Synthesis 9

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

Total: 45 Periods

Passed in Board of studies Meeting on 23.10.2020 *Approved in Academic Council Meeting on 06.11.2020*

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Reference Books:

1. Joseph Mariani, —Language and Speech Processingll, Wiley, 2009.
2. Lawrence Rabiner and Bling-Hwang Juang, —Fundamentals of Speech Recognitionll, Prentice Hall Signal Processing Series, 1993.
3. Sadaoki Furui, —Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)ll, Marcel Dekker, 2000.
4. Thomas F.Quatieri, —Discrete-Time Speech Signal Processingll, Pearson Education, 2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, —Spoken Language Processing – A guide to Theory, Algorithm and System Developmentll, Prentice Hall PTR, 2001.

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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

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20PCSE35	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 IV Software Quality 9

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

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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, Kshirasagar Nak Priyadarshi Tripathy, 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, Milind Limaye, 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

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SEMESTER III

20PEE301	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 literature's 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 research problem	Apply
CO2	Concentrate on literature's 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 instrumentation.

Unit- II Literature Review **9**

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

Unit - III Technical Writing /Presentation **9**

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 Property Rights (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 Property Rights (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

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Text Books:

1. Ahuja.V.K, "Intellec ıal Property Rights" Lexis Nexis Publishers 3rd Edition 2019.
2. Pandey Neeraj and harni Khushdeep, "Intellectual Property Rights", PHI publishers, 5th Edition 2018.
3. Halbert, "Resisting Ir. ellectual 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				

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20PCS301	PROJECT WORK PHASE – I	L	T	P	C
		0	0	20	10
Nature of Course	Employability Enhancement Courses (EEC)				
Prerequisites	Programming Languages, Software Engineering				

Course Objectives

The course is intended to

1. Discover potential research areas in the field of Computer Science and Engineering.
2. Compare and contrast the several existing solutions for the problem identified.
3. Formulate and propose a plan for creating a solution for the research plan identified.
4. Conduct the experiments as a team and interpret the results.
5. Report and present the work findings.

Course Outcomes

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

CO.No	Course Outcome	Bloom's Level
CO 1	Identify prospective research domains within the realm of Computer Science and Engineering.	Understand
CO 2	Examine and differentiate among various available solutions addressing the identified problem.	Apply
CO 3	Evaluate and suggest a strategy for crafting a solution to address the identified research plan.	Analyze
CO 4	Summarize the analysed findings obtained from the experiments	Evaluate
CO 5	Compile and present the results of the conducted work	Create

Course Contents

1. The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report.
2. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.
3. A project report is required at the end of the semester.

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4. The project work is evaluated based on oral presentation and the project report jointly by externa and internal examiners constituted by the Head of the Department.

Total Periods:

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
CO 1	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 2	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 3	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 4	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 5	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
3-High					2-Medium				1-Low						

Formative Assessment				
Blooms Taxonomy	Assessment Component	Marks		Total marks
		Committee	Guide	CA
Understand Apply	Review 1	5	5	50
Analyze Evaluate	Review 2	5	5	
Create	Review 3	5	5	
Publications		5	5	
Report		5	5	

Summative Assessment				
Assessment Component	Continuous Assessment (CA)			Final Examinations (FE)
	Committee	Guide	Total	50
Review 1	5	5	50	50

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PROFESSIONAL ELECTIVE – SEMESTER III

20PCSE41	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 and apply to models systems
3. Comprehend formal specification models based on set theory, calculus and algebra and apply to a case study
4. Implement Z, Object Z and B Specification languages with case studies

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).

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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. Michael Muth and Mark Ryan, "Logic in Computer Science- modeling and reasoning about systems", Cambridge University Press, 2nd Edition 2019.
2. M.Ben-Ari, "Mathematical Logic for computer science", Springer, 3rdEdition, 2018.

Reference Books:

1. Antoi Diller, "Z: An Introduction to formal methods", Wiley Publisher, 2nd Edition 2019.
2. Jonathan Jacky , "The ways Z: Practical programming with formal methods", Cambridge UniversityPress,3rd Edition 2017.
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		

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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

Passed in Board of studies Meeting on 23.10.20

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Approved in Academic Council Meeting on 23.10.

20PCSE42	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
Nature of Course	Professional Elective	3	0	0	3
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

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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

Passed in Board of studies Meeting on 23.10.20

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Approved in Academic Council Meeting on 23.10.20

20PCSE43	MACHINE LEARNING TECHNIQUES	L	T	P	C
Nature of Course	Professional Elective	3	0	0	3
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

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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/preview3.
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

Passed in Board of studies Meeting on 23.10.20 *Approved in Academic Council Meeting on 23.10.20*

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20PCSE44	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

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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 and Karamanoglu, "Swarm Intelligence and Bio-Inspired Computing", Elsevier ,1stEdition 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

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20PCSE45	HIGH SPEED NETWORKS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Computer Networks				

Course Objectives

The course is intended to

1. Plan the basic concepts of frame relay and ATM networks.
2. Learn the techniques involved to support real-time traffic and congestion control.
3. Study the end to end performance parameters and techniques used by TCP.
4. Update knowledge about the development in high speed networks.
5. Incorporate different levels of quality of service to different applications.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Implement the basic concept of protocols and architectures	Apply
CO2	Analyze the different queuing techniques.	Analyze
CO3	Apply the knowledge about Asynchronous transfer protocol and TCP/IP	Apply
CO4	Compare the different types of service and queuing types	Analyze
CO5	Develop the different types of protocols of quality of service in different applications.	Apply

Course Contents:

UNIT- I High Speed Networks 9

Frame Relay Networks – Asynchronous transfer mode: ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories, AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel - Wireless LANs: applications, requirements, Architecture of 802.11

UNIT- II Congestion and Traffic Management 9

Queuing Analysis: Queuing Models, Single Server Queues - Effects of Congestion - Congestion Control - Traffic Management - Congestion Control in Packet Switching Networks - Frame Relay Congestion Control.

UNIT- III Tcp and Atm Congestion Control 9

TCP Flow control - TCP Congestion Control: Retransmission Timer Management, Exponential RTO back off, KARN"s Algorithm, Window management – Performance of TCP over ATM -Traffic and Congestion control in ATM – Requirements, Attributes, Traffic Management Frame work, Traffic Control

UNIT- IV Integrated and Differentiated Services 9

Integrated Services Architecture: Approach, Components, Services- Queuing Discipline: FQ, PS, BRFQ, GPS, WFQ – Random Early Detection - Differentiated Services.

UNIT -V Protocols for QoS Support 9

RSVP: Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching: Operations, Label Stacking – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

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TOTAL: 45 Periods

Text Books:

1. William Stallings, "High speed networks and Internets Performance and Quality of Service", Pearson Education Asia, 2nd Edition 2018.
2. William Stallings, "High Speed Networks and Internet", Pearson Education, 1stEdition, 2015.

Reference Books:

1. IrvanPepelnjk, Jim Guichard, and Jeff Apcar, "MPLS and VPN architecture", Cisco Press, 4th Edition 2019.
2. Abhijit S. Pandya and Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press New York, 2nd Edition 2018.
3. Warland and Pravin Varaiya, "High performance communication networks", Jean Harcourt Asia Pvt. Ltd.,3rd Edition 2017.

Additional References:

1. https://www.classcentral.com/course/swayam-computer-networks-and-internet-protocol-17551
2. http://www.digimat.in/nptel/courses/video/117106089/L36.html
3. https://nptel.ac.in/courses/106/105/106105183/

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

Passed in Board of studies Meeting on 23.10.20

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SEMESTER -IV

20PCS401	PROJECT WORK PHASE – II	L	T	P	C
		0	0	20	10
Nature of Course	Employability Enhancement Courses (EEC)				
Prerequisites	Programming Languages, Software Engineering				

Course Objectives

The course is intended to

6. Discover potential research areas in the field of Computer Science and Engineering.
7. Compare and contrast the several existing solutions for the problem identified.
8. Formulate and propose a plan for creating a solution for the research plan identified.
9. Conduct the experiments as a team and interpret the results.
10. Report and present the work findings.

Course Outcomes

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

CO.No	Course Outcome	Bloom's Level
CO1	Identify prospective research domains within the realm of Computer Science and Engineering.	Understand
CO2	Examine and differentiate among various available solutions addressing the identified problem.	Apply
CO3	Evaluate and suggest a strategy for crafting a solution to address the identified research plan.	Analyze
CO4	Summarize the analysed findings obtained from the experiments	Evaluate
CO5	Compile and present the results of the conducted work	Create

Course Contents

1.The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report.

2.The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

3. A project report is required at the end of the semester.

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4.The project work is evaluated based on oral presentation and the project report jointly by externa and internal examiners constituted by the Head of the Department.

Total Periods: 300 Hrs

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
CO 6	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 7	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 8	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 9	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
CO 10	3	3	3	2	3	1	1	2	3	3	2	2	2	2	3
3-High					2-Medium				1-Low						

Formative Assessment				
Blooms Taxonomy	Assessment Component	Marks		Total marks
		Committee	Guide	CA
Understand Apply	Review 1	5	5	50
Analyze Evaluate	Review 2	5	5	
Create	Review 3	5	5	
Publications		5	5	
Report		5	5	

Summative Assessment				
Assessment Component	Continuous Assessment (CA)			Final Examinations (FE)
	Committee	Guide	Total	50
Review 1	5	5	50	50

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PROFESSIONAL ELECTIVE – SEMESTER IV

20PCSE51	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

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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, 2nd Edition 2020.
2. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", No Starch Press Inc, 4th Edition 2018.
3. Chandrajit Bajaj,"Data Visualization Techniques", Wiley-Blackwell Publisher, 2nd Edition 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

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20PCSE52	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 salientfeaturesofdifferentreconfigurablearchitectures.	Analyze
CO3.	Implement the different typesof computermodelsforprogrammingreconfigurable 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

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

UNITII Reconfigurable Computing Architectures and Systems 9

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

UNITIII Programming Reconfigurable Systems 9

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

UNITIV Mapping Designs to Reconfigurable Platforms 9

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

UNITV Application Development with FPGAS 9

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

TOTAL: 45PERIODS

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Text Books:

1. Christophe Bobda, "Introduction to Reconfigurable Computing-Architectures, Algorithms and Applications", Springer, 5th Edition 2020.
2. May a Gokhale. Band Paul S.Graham, "Reconfigurable Computing: Accelerating Computation with Field- Programmable Gate Arrays", 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

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20PCSE53	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" A press, 2nd Edition 2018.
3. David Mark, Jack Nutting, Jeff LaMarche 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 Edition 2019.
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)															
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

Passed in Board of studies Meeting on 23.10.20 *Approved in Academic Council Meeting on 23.10.20*

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20PCSE54	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 Mc Graw hill Publishers,5th Edition 2015.

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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

Passed in Board of studies Meeting on 23.10.20

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20PCSE55	INFORMATION STORAGE AND MANAGEMENT	L	T	P	C
Nature of Course	Professional Elective	3	0	0	3
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.	Select from various storage technologies to suit for required application	Analyze
CO2.	Apply security measures to safeguard storage &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

Passed in Board of studies Meeting on 23.10.20

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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. Somasundaram Gnana Sundaram Alok Shrivastava,"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.html3.
https://nptel.ac.in/courses/106/105/106105175/

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			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

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