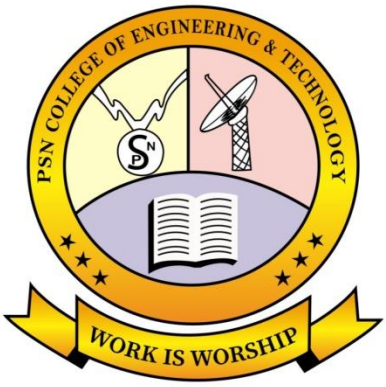
PSN College of Engineering and Technology



Department of Computer Science and Engineering

M.E - Computer Science and Engineering

R 2022- Curriculum and Syllabus (I to IV Semester)

PSN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution Recognised by AICTE, New Delhi
and Affiliated to Anna University, Chennai)
Accredited with A+ Grade by NAAC. An ISO 9001:2015 Certified Institution
Melathediyoor, Tirunelveli – 627 152

REGULATIONS – R2022 (Full Time)

M.E - Computer Science and Engineering

INDEX

Vision and Mission of the Institute

Vision

Emerge as a pioneer institute inculcating engineering education and skills, research, values and ethics.

Mission

- **To achieve greater heights of excellence in technical knowledge and skill development through innovative teaching and learning practices.**
- **To develop the state of art infrastructure to meet the demands of technological revolution.**
- **To improve and foster research in all dimensions for betterment of society.**
- **To develop individual competencies to enhance innovation, employability and entrepreneurship among students.**
- **To instill higher standards of discipline among students, inculcating ethical and moral values for societal harmony and peace**

Vision and Mission of the Department

Vision

To emerge as a preeminence program to produce quality Computer Science and Engineering graduates.

Mission

- **To enhance professional and entrepreneurial skills through industry institute interaction to enable them in getting better placement**
- **To promote research and continuing education**
- **To train the students according to their discipline to meet dynamic needs of the society**

Program Outcomes (POs)

PO's No	KNOWLEDGE	STATEMENTS
1	Engineering Knowledge:	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem Analysis:	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design / Development of Solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct Investigations of Complex Problems:	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	Modern Tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an UN 2 of the limitations.
6	The Engineer and Society:	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	Environment and Sustainability:	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics:	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9	Individual and Team Work:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication:	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project Management and Finance:	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long Learning:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

S.No	Topic	PEOs
PEO1	**Fundamental Knowledge**	Graduates will be able to perform in technical and managerial roles ranging from design, development and problem solving to suit to the industrial needs
PEO2	**Career Development**	Graduates will be able to successfully pursue higher education and also Graduates will have the ability to adapt, contribute and innovate new technologies in different domains of Computer Science and Engineering
PEO3	**Social Identity**	Graduates will be ethically and socially responsible engineers in Computer Science and Engineering disciplines

Program Specific Outcomes (PSOs)

Graduating student shall be able to:

PSO1	Proficient and Innovative with a strong cognizance in the IOT, through the application of acquired knowledge and skills.
PSO2	Design and Implement IOT based solutions for improving operational efficiency by investigating existing industrial environment.

PSN COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

Distribution of Courses - M.E (R22)

Sl. No	Course code	Course Name	Classification		L	T	P	C
		SEMESTER I						
1	CS624001	Applied Mathematics	PC		3	1	0	4
2	CS624002	Advanced Computer Architecture	PC		3	0	0	3
3	CS624003	Advanced Data Structures and Algorithms	PC		3	0	0	3
4	CS624004	Cryptography and Hashing	PC		3	0	0	3
5		Programme Elective -I	PE		3	0	0	3
6	AP620004	Research Methodology	IC		3	0	0	3
7	CS624501	Technical Seminar-I	EEC		2	0	0	1
8	CS624101	Data Structures Laboratory	PC		0	0	4	2
9		English for Manuscript Writing	IM		2	0	0	0
		SEMESTER II						
10	CS624005	Digital Image Processing Tools and Techniques	PC		3	0	0	3
11	CS624006	Network Design and Technologies	PC		3	0	0	3
12	CS624007	Cloud Computing Technologies	PC		3	0	0	3
13	CS624008	Internet Security	PC		3	0	0	3
14		Programme Elective -II	PE		3	0	0	3
15		Programme Elective -III	PE		3	0	0	3
16	CS624102	Image Processing Laboratory	PC		0	0	4	2
17		Literature reading skills	IM		2	0	0	0
		SEMESTER III						
18		Programme Elective-IV	PE		3	0	0	3
19		Programme Elective-V	PE		3	0	0	3
20		Institute Elective	IE		3	0	0	3
21	CS624301	Project Phase - I	EEC		0	0	8	8
		SEMESTER IV						
22	CS624302	Project Phase - II & Journal Publication	EEC		0	0	12	12
23	CS624502	Technical Seminar-II	EEC		2	0	0	1

Sl. No	Subject Code	Subject Name	L	T	P	C	Total Periods
Programme Elective -I [Sem-I]							
1	CS624201	Advanced Databases Technologies	3	0	0	3	45
2	CS624202	Web Engineering	3	0	0	3	45
3	CS624203	Artificial Intelligence	3	0	0	3	45
4	CS624204	Service Oriented Architecture	3	0	0	3	45
5	CS624205	Information Storage Management	3	0	0	3	45
Programme Elective -II [Sem-II]							
1	**CS624206**	**Internet of Things**	3	0	0	3	45
2	CS624207	Big Data Analytics	3	0	0	3	45
3	CS624208	Mobile and Pervasive Computing	3	0	0	3	45
4	CS624209	Software Reliability and Metrics	3	0	0	3	45
5	CS624210	Fuzzy Logic and its Applications	3	0	0	3	45
Programme Elective -III [Sem-II]							
1	**CS624211**	**Software Quality Assurance and Testing**	3	0	0	3	45
2	CS624212	Cognitive Computing	3	0	0	3	45
3	CS624213	Social Network Analysis	3	0	0	3	45
4	CS624214	Data Mining Techniques	3	0	0	3	45
5	CS624215	Blockchain Technologies	3	0	0	3	45
Programme Elective -IV [Sem-III]							
1	CS624216	Agent Based Systems	3	0	0	3	45
2	CS624217	Machine Learning	3	0	0	3	45
3	CS624218	Android Application Development	3	0	0	3	45
4	CS624219	**Soft Computing Techniques**	**3**	**0**	**0**	**3**	**45**
5	CS624220	Bio-informatics	3	0	0	3	45
Programme Elective -V [Sem-III]							
1	CS624221	**Multimedia and Compression Techniques**	3	0	0	3	45
2	CS624222	Data Visualization Techniques	3	0	0	3	45
3	CS624223	Python with R program	3	0	0	3	45
4	CS624224	Formal Model and Software Systems	3	0	0	3	45
5	CS624225	Software Project Management	**3**	**0**	**0**	**3**	**45**

Institute Elective

Sl. No	Subject Code	Subject Name	L	T	P	C	Total Periods
1	**CS624901**	Modern Sensor Technology	3	0	0	3	45
2	**CS624902**	Decision Support and Intelligent Systems	3	0	0	3	45

I SEMESTER

CS624001/ Applied mathematics

Course Category: Programme Core	Course Type: Theory	L	T	P	C
		3	0	0	3

Unit I – PROBABILITY AND RANDOM VARIABLES	**9**
Probability - Baye's Theorem and Applications - Discrete and Continuous Random Variables - Discrete Probability Distributions - Binomial, Poisson and Geometric - Continuous Probability Distributions - Uniform, Exponential and Normal	
Unit II – QUEUING MODELS	**9**
Poisson Process - Markovian Queues - Single and Multi-Server Models - Little's Formula - Machine Interference Model - Self Service Queue -Non- Markovian Queues - PollaczekKhintchine Formula	
Unit III – SIMULATION	**9**
Discrete Even Simulation - Monte - Carlo Simulation - Stochastic Simulation – Applications to Queuing systems	
Unit IV – LINEAR PROGRAMMING	**9**
Formulation - Graphical Solution - Simplex Method - Two Phase Method - Transportation and Assignment Problems	
Unit V- NON-LINEAR PROGRAMMING	**9**
Lagrange Multipliers - Equality Constraints - Inequality Constraints - Kuhn - Tucker conditions - Quadratic Programming.	
TOTAL: 45 PERIODS	

CS624002: Advance Computer Architecture					
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To gain knowledge about the fundamentals of Computer design.
- To understand the basics and features of ILP with dynamic approaches.
- To provide the knowledge about the ILP with software approaches.
- To learn about the Concept of features of multiprocessors.
- To understand the concept of Memory organization features.

Unit 1 FUNDAMENTALS OF COMPUTER DESIGN AND PIPELINING	
Introduction – Designing for performance-Measuring and Reporting Performance - Quantitative Principles of Computer Design - Instruction Set Principles and Examples - Classifying Instructions Set Architectures - Memory Addressing - Addressing Modes for Signal Processing - Type and Size of Operands – Pipelining - Basic Concepts - Hazards – Implementation.	**9**
Unit 2 ILP WITH DYNAMIC APPROACHES	
Concepts and Challenges - Overcoming Data Hazards with Dynamic Scheduling - Examples - Reducing Branch Costs with Dynamic Hardware Prediction - Taking Advantages of ILP with Multiple Issues - Limitations of ILP-Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading.	**9**
Unit 3 ILP WITH SOFTWARE APPROACHES	
Basic Compiler Techniques for Exposing ILP - Static Branch Prediction - Static Multiple Issues: VLIW Approach - Advanced Compiler Support for Exposing - Hardware Support - Cross Cutting Issues - Intel IA64 Architecture.	**9**
Unit 4 MULTIPROCESSORS AND MULTICORE ARCHITECTURES	
Symmetric and Distributed Shared Memory Architectures - Distributed Shared Memory and Directory-Based Coherence- Performance Issues - Synchronization Issues - Models of Memory Consistency - Software and Hardware Multithreading-Intel Multicore Architectures –SUN CMP architecture – IBM Cell Architecture.	**9**
Unit 5 MEMORY AND I/O	
Introduction - Review of Caches - Cache Performance - Reducing Cache Miss Penalty - Reducing Miss Rate - Reducing Hit Time - Optimizations of Cache Performance — Design of Memory Hierarchies- Main Memory and Organizations for Improving Performance - - Virtual Memory Storage Systems - Types of Storage Devices - Buses - Reliability - - I/O Performance Measures.	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to	
CO1	Gain knowledge about the fundamentals of Computer design.
CO2	Understand the basics and features of ILP with dynamic approaches.
CO3	Provide the knowledge about the ILP with software approaches.
CO4	Learn about the Concept of features of multiprocessors.
CO5	Understand the concept of Memory organization features.

REFERENCE BOOKS:
1. John L. Hennessey and David A. Patterson, "Computer Architecture: A Quantitative Approach", Morgan Kaufmann, Fourth Edition, 2006.
2. D. Sima, T. Fountain and P. Kacsuk, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, Seventh Edition, 2009.
3. Computer Organization and Architecture, William Stallings ,8th edition, PHI.

CS624003: Advanced Data structures and Algorithms					
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

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

Unit 1 Algorithm and Analysis of Algorithm	
Algorithms – Algorithms as a problem solving technique – Time and Space complexity of algorithms- Asymptotic analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms- Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms.	**9**
Unit 2 Hierarchical Datastructures	
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- Heap – Heap Implementation – Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.	**9**
Unit 3 Graphs	
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search –Strongly Connected Components- Minimum Spanning Trees: 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: The Floyd-Warshall Algorithm	**9**
Unit 4 Algorithm Design Techniques	
Dynamic Programming: Multi-stage graphs – Flow Shop Scheduling; Greedy Algorithm: Tree vertex Splitting – Job sequencing with deadlines; Backtracking: Graph Coloring – Knapsack Problem	**9**
Unit 5 NP – Complete and NP - Hard	
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems: Clique Decision Problem – Traveling Salesman Problem.	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Design algorithms for various computing problems and analyze the time and space complexity of algorithms.
CO2 : Identify and implement tree data structures and apply them to solve problems.
CO3 : Identify and implement graph data structures and apply them to solve problems.
CO4 : Ability to understand and design algorithms using appropriate algorithm design techniques for the given problem.

CO5 : Ability to understand role the NP – Complete and NP – Hard Problems in solving real world problems.

CO-PO MAPPING

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

REFERENCE BOOKS:

1. S.Sridhar, “Design and Analysis of Algorithms”, Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, “Data Structures and algorithms in C++”, Cengage Learning, 4th Edition, 2013.
3. Ellis Horowitz, SartajShani, SanguthevarRajasekaran, “Fundamentals Of Computer Algorithms”. India, Misc, 2010.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", Second Edition, Prentice Hall of India Ltd
5. Mark Allen Weiss, “Data Structures and Algorithms in C++”, Pearson Education, 3rd Edition, 2009
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint, 2006.

CS624004: Cryptography and Hashing					
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the fundamental concepts and techniques in cryptography and network security
- To illustrate the working principles of various Symmetric Ciphers.
- To explore knowledge on Asymmetric Ciphers.
- To study system boot and the Init process.
- To learn the various Hash function.
- To realize the Construction.

Unit 1 INTRODUCTION	
Computer Security Concepts- OSI Security Architecture- Security Attacks- Security Services- Security Mechanisms-Model for Network Security-Classical Encryption Techniques- Symmetric Cipher Model-Substitution Techniques-Transposition Techniques- Rotor Machines- Stegnography- Basic Concepts in Number Theory and Finite Fields-Divisibility and the Division Algorithm- Euclidean Algorithm- Modular Arithmetic-Groups, Rings, and Fields- Finite Fields of the Form GF(p)	**9**
Unit 2 MODERN SYMMETRIC CIPHERS	
Block Ciphers and the Data Encryption Standard-Block Cipher Principles-The Data Encryption Standard (DES)- Strength of DES-Differential and Linear Cryptanalysis-Block Cipher Design Principles-Advanced Encryption StandardBlock Cipher Modes of Operation- Stream Ciphers-RC4	**9**
Unit 3 ASYMMETRIC CIPHERS	
Prime Numbers- Fermat's and Euler's Theorems- Testing for Primality- Chinese Remainder Theorem-Discrete Logarithms- Principles of Public-Key Cryptosystems-RSA Algorithm- Diffie-Hellman Key Exchange- ElGamal Cryptosystem- Elliptic Curve Arithmetic- Elliptic Curve Cryptography	**9**
Unit 4 HASH FUNCTION	
Block cipher Based hash function - Non-Block cipher Based hash function - Design principles - Methods of Attack on Hash function	**9**
Unit 5 CONSTRUCTION	
Theoretic Construction - Hard bit and Pseudo random bit generation - strong one-way permutation - UOWHF Construction and PBG -Strong one-way permutation	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Apply essential mathematical concepts to Cryptography and identify the vulnerabilities in Classical cryptosystems

CO2 : Experiment Symmetric-Key cipher algorithms

CO3 : Apply Asymmetric-Key Cryptographic techniques

CO4 : Manipulate the Hash function

CO5 : Demonstrate cryptographic Hash function to real-time applications

CO PO MAPPING

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

REFERENCE BOOKS:

1. William Stallings, "Cryptography and network Security", Pearson, Sixth edition, 2013.
2. Alan G. Konheim, "Computer security & cryptography", John Wiley & Sons, 2007.
3. Josef Pieprzyk Babak Sadeghiyan ,"Design of hashing Algoritms ",Springer-Verlag 1993
4. Charles P. Pfleeger, Shari Lawrence Pfleeger, "Security in computing", Prentice Hall of India, Third Edition, 2006.
5. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson, Second edition, 2007
6. Behrouz A.Forouzan, "Cryptography and Network Security", Tata McGraw Hill, 2010.
7. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007

AP620004 -RESEARCH METHODOLOGY					
Course Category: Institutive core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Impart knowledge on basics of research methodology
- Explore knowledge in technical writing in an efficient manner
- Understand research problem formulation and analyses the research related information
- Understand the importance of IPR
- Apply the knowledge of IPR in various research projects

UNIT - I **RESEARCH PROCESS**	
Research ethics - Research process: characteristics and requirements, Types of research, Research process: eight step model - formulating research problem, conceptualizing research design, constructing instrument for data collection, Selecting a sample, writing a research proposal, collecting data, processing data, writing research report.	**9**
UNIT - II **RESEARCH WRITING**	
Effective literature studies approaches - technical document structuring - how to write report and research paper - format of research proposal - developing research proposal - presentation and assessment by a review committee.	**9**
UNIT - III **DESIGN OF EXPERIMENTS**	
Strategy of Experimentation - Typical applications of experimental design - Guidelines for designing experiments - Basic statistical concepts - Statistical concepts in experimentation - Regression approach to analysis of variance.	**9**
UNIT - IV **INTELLECTUAL PROPERTY**	
Patents, Industrial designs and IC layout Designs, Trade Marks and Copyright, Geographical Indications, IPR management: 5Cs model of managing IP, Emerging issues in IPR.	**9**
UNIT - V **ROADMAP FOR PATENT CREATION**	
Types of patent - Parts of a patent document - Terminologies and codes used in patent document - Patent searching and analysis – Indicators for patentability - IP identification tool – public patent data base – Transfer and infringement of patent rights – Patent commercialization.	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO2 : Correlate the results of any research article with other published results. Write are view article in the field of engineering

CO3 : Understand research problem formulation & Analyze research related information and Follow research ethics

CO4 : Appreciate the importance of IPR and protect their intellectual property.

CO5 : Understand that PR protection provides an incentive to inventors for further research work

and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

CO PO MAPPING

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

REFERENCE BOOKS:

1. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005.

2. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.

3. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

4. Kothari, C. R. Research Methodology - Methods and Techniques, New Age Internationalpublishers, New Delhi, 2004.

5. Robert P. Merges, Peter S. Menell and Mark A. Lemley, “Intellectual Property in New Technological Age”, Aspen Publishers, 2016

CS624101: DATA STRUCTURES LABORATORY

Course Category: Programme Core	Course Type: Theory	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Design and implement basic data structures.

CO2 : Implement advanced data structures extensively

CO3 : Design algorithms using graph structures

CO4 : Design and develop efficient algorithms with minimum complexity using design techniques

CO5 : Understand and develop Dynamic programming algorithms.

CO PO MAPPING

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

REFERENCE BOOKS:

1. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.
2. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint, 2006

II SEMESTER

CS624005: Digital Image Processing Tools and Techniques					
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide the basic knowledge of Digital Image Processing.
- To Know the various image enhancement techniques.
- To understand the various concepts of image segmentation.
- To Learn about compression techniques.
- To extract features for image analysis and also illustrate 3D image visualization

Unit 1 INTRODUCTION TO DIGITAL IMAGE PROCESSING	
Image Representation and Image Processing Paradigm - Elements of digital image processing. Sampling and quantization-Relationships between pixels- Connectivity, Distance Measures between pixels - Color image (overview, various color models)- Various image formats bmp, jpeg, tiff, png, gif.	**9**
Unit 2 IMAGE ENHANCEMENT	
Enhancement by point processing, Sample intensity transformation, Histogram processing, Image subtraction, Image averaging, Spatial filtering- Smoothing Spatial filters, Sharpening Spatial filters, Frequency domain- Fourier Transform, Low-Pass, HighPass, Laplacian, Homomorphic filtering.	**9**
Unit 3 IMAGE SEGMENTATION	
Edge detection, Thresholding, Region growing, Fuzzy clustering, Water shed algorithm, Active contour models, Texture feature based segmentation, Graph based segmentation, Wavelet based Segmentation-Applications of image segmentation. Region oriented segmentation- Histogram based segmentation.	**9**
Unit 4 IMAGE COMPRESSION	
Lossless compression versus lossy compression-Measures of the compression efficiency- Huf- mann coding-Bitplane coding-Shift codes-Block Truncation coding-Arithmetic coding-Predictive coding techniques-Lossy compression algorithm using the 2-D. DCT transform-The JPEG 2000 standard Baseline lossy JPEG, based on DWT	**9**
Unit 5 FEATURE EXTRACTION AND 3D IMAGE VISUALIZATION	
Feature extraction: Histogram based features - Intensity features-Color, Shape features-Contour extraction and representation-Homogenous region extraction and representation. Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing in 3D, Measurements on 3D images	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Understand the basic Concepts of Digital Image Processing and its equivalent open source tools

CO2 : Apply different Algorithm by utilizing Enhancement Techniques

CO3 : Learn and apply different Segmentation Techniques in an Image Processing

CO4 : Explore the possibility of applying various Compression Techniques in an Image processing applications

CO5 : Analyze different Feature extraction approaches to image processing applications

CO PO MAPPING

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

REFERENCE BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., PrenticeHall, 2008
2. William K. Pratt, Digital Image Processing, John Wiley, 4th Edition, 2007
3. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997
4. Sonka, Fitzpatrick, Medical Image Processing and Analysis, 1st Edition, SPIE,2000

CS624006: Network Design and Technologies					
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the principles required for network design
- To explore various technologies in the wireless domain
- To understand the various protocols of wireless and cellular networks
- To study about 4G and 5G cellular networks
- To understand the paradigm of Software defined networks

Unit I Network Design	
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.	**9**
Unit II Wireless Networks	
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	**9**
Unit III Cellular Networks	
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	**9**
Unit IV 4G Networks	
LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G	**9**
Unit V Software Defined Networks	
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	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Identify the components required for designing a network

CO2 : Design a network at a high-level using different networking technologies

CO3 : Analyse the various protocols of wireless and cellular networks

CO4 : Discuss the features of 4G and 5G networks

CO5 : Experiment with software defined networks

CO PO MAPPING

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

REFERENCE BOOKS:

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‖, 6 th edition, Morgan Kauffman, 2021
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

CS624007: Cloud Computing Technologies					
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To understand the concept of cloud and utility computing.
- To understand the various issues in cloud computing.
- To familiarize themselves with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.
- To be able to set up a private cloud.

Unit 1 INTRODUCTION	
Introduction - Historical Development - Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics – Cloud Deployment Models: Public, Private, Community, and Hybrid Clouds - Cloud Delivery Models: IaaS, PaaS, SaaS – Open Source Private Cloud Software: Eucalyptus, Open Nebula, Open Stack	**9**
Unit 2 VIRTUALIZATION	
Data Center Technology - Virtualization - Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing – Pros and Cons of Virtualization - Implementation Levels of Virtualization - Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V	**9**
Unit 3 CLOUD COMPUTING MECHANISM	
Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, Billing Management System	**9**
Unit 4 HADOOP AND MAP REDUCE	
Apache Hadoop – Hadoop Map Reduce – Hadoop Distributed File System- Hadoop I/O Developing a Map Reduce Application - Map Reduce Types and Formats - Map Reduce Features– Hadoop Cluster Setup – Administering Hadoop	**9**
Unit 5 SECURITY IN THE CLOUD	
Basic Terms and Concepts – Threat Agents – Cloud Security Threats – Cloud Security Mechanism: Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups, Hardened Virtual Server Images	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1 : Articulate the main concepts, key technologies, strengths and limitations of cloud computing
CO2 : Identify the architecture, infrastructure and delivery models of cloud computing
CO3 : Explain the core issues of cloud computing such as security, privacy and interoperability
CO4 : Choose the appropriate technologies, algorithms and approaches for the related issues
CO5 : Understanding the concepts of Big data tool and its analysis techniques

CO PO MAPPING

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

REFERENCE BOOKS:

1. Thomas Erl, Zaigham Mahood, Ricardo Puttini, “Cloud Computing, Concept, Technology and Architecture”, Prentice Hall, 2013

2. Toby Velte, Anthony Velte, Robert C. Elsenpeter, “Cloud Computing, A Practical Approach”, Tata McGraw-Hill Edition, 2010

3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, Tata McGraw-Hill, 2013

CS624008: Internet Security					
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To study the fundamental concepts of classical encryption techniques and Crypt Analysis.
- To understand the principles of secret keys management.
- To acquire the concepts of IP Security and its applications
- To study the concepts of Transport layer security and its applications
- To learn the working principle of Email and public key distribution

Unit 1 INTRODUCTION AND BASIC ENCRYPTION	
Introduction – Essentials of Cryptography, Essentials of Networking and Internet, Security Objectives, Communication Security, Legal restrictions, Basics of Encryption – Building Blocks of Encryption, Cryptanalysis and Modern Codes, Brute Force cracking of Secret Keys, Choosing Cryptography Algorithms	**9**
Unit 2 LINK ENCRYPTION AND SECURE KEY MANAGEMENT	
Link Encryption – In-line Encryptor, Point to Point Encryption, IP Routed Configuration, Managing Secret Keys – Issues in Secret Key Management, Technology - Random Key Generation, Random Seeding, Pseudorandom Number Generators, Manual Key Distribution, Automatic Rekeying, Key Distribution Centres, Maintaining Keys and System Security	**9**
Unit 3 IP LAYER SECURITY AND APPLICATIONS	
Basic Issues in IP Security (IPSEC), Cryptographic Checksums, IP Security Protocol, IPSEC key management, TCP/IP Network Security Protocols, Virtual Private Network (VPN) – Issues in VPN, IPSEC proxy cryptography, IPSEC encrypting Router, Site to Site Encryption, Remote Access with IPSEC – problems in IPSEC clients, IPSEC Client, Client to Server site access	**9**
Unit 4 TRANSPORT LAYER SECURITY AND APPLICATIONS	
Public Key Cryptography, RSA Encryption, Key Exchange with RSA, Secure Socket Layer (SSL), World Wide Web Transaction Security – Issues in Internet Transaction Security, Transactions on World Wide Web, Security Alternatives for Web Forms, Web Browser with SSL, Web Server with SSL	**9**
Unit 5 SECURE E-MAIL AND PUBLIC KEY CERTIFICATES	
Secure Email - Email Security Issues, Basics of Internet E-Mail, Offline Message Keying, Digital Signature, Secure Email Client, Public Key Certificates – Distributing Public Keys, Public Key Certificates, Certificate Distribution, Centralized Certification Authority, Hierarchical Certification Authority, Pretty Good Privacy (PGP)	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1 : Interpret basic building blocks of encryption for cryptanalysis
CO2 : Identify suitable key generation technique for secret key management
CO3 : Apply IP security in VPN and Remote Access
CO4 : Apply SSL in World wide web transactions

CO5 : Discover various public key and certificate distribution strategies and its use in PGP

CO PO MAPPING

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

REFERENCE BOOKS:

1. Richard E.Smith, Internet Cryptography, 6th Edition, Pearson, 2011
2. Tim Speed, Juanita Ellis, "Internet Security", Elsevier, 2006
3. Uyless Black, "Internet Security Protocols – Protecting IP Traffic", Pearson Education, 2001
4. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 2nd edition, Pearson, 2007
5. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013
6. Bruce Schneier and Neils Ferguson, ―Practical Cryptography‖, First Edition, WileyDreamtech India Pvt Ltd, 2003
7. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007
8. Douglas R Simson ―Cryptography –Theory and practice‖, First Edition, CRC Press,1995

CS624102: IMAGE PROCESSING LABORATORY

Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To learn Image Processing Techniques
- To display various Images in Image Processing
- To implement Various Segmentation Techniques in Image Processing
- To implement Image restoring techniques .
- To implement slicing technique for image enhancement

LIST OF EXPERIMENTS

1. Display of Grayscale Images Image, Negative of an Image (Binary & Gray Scale)
2. Implementation of Relationships between Pixels.
3. Implementation of Transformations of an Image .
4. Implementation of image restoring techniques
5. Implementation of Image Intensity slicing technique for image enhancement
6. Implementation of Canny edge detection Algorithm
7. Implement the Algorithm for Edge detection using Operators
8. Implementation of Segmentation using watershed transform.
9. Implementation of Histogram Equalization Algorithm.
10. Implementation of Non-linear Filtering Techniques.
11. Implement the Algorithm for Edge detection using Operators.
12. Implementation of Filtering in frequency domain

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : learn Image Processing Techniques

CO2 : implement Various Segmentation Techniques in Image Processing

CO3 : implement slicing technique for image enhancement

CO PO MAPPING

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

PROGRAMME
ELECTIVE -I [SEM-I]

CS624201: Advanced Database Technologies					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To know the fundamental Concepts of Database Management.
- To define a good database design
- To define query processing using views
- To explain the importance of security in statistical databases
- To state the principle of design of distributed database management system

Unit 1 Overview	
Overview of a Database Management Systems – Evolution of Database Management Systems – Basics of the Relational Model – Design of Relational Database Schemas – High level Database Models: Design principles – Algebraic and Logical Query Languages – Database Language SQL – SQL in a Server Environment – Semi-structured Data Model – Data Mining – Information Integration	**9**
Unit 2 Query Processing and Evaluation	
Query Processing: An Introduction: optimization – measure of query cost – select operation – sorting – Join operation: Nested loop – Block nested loop – Indexed nested loop – merge join – hash join – complex join – other operations – Representation and Evaluation of Query Expression – Creation of Query Evaluation Plans – View and Query Processing	**9**
Unit 3 Relational Database Design	
Overview – Basics of the Relational Model – Features of Good Database Design – Enhanced ER Tools – Functional Dependency: Theory and Normalization – Multivalued Dependency – Fourth Normal Forms – Join Dependency – Fifth Normal Form – Inclusion Dependency – Template Dependency - Domain Key Normal Form – Modeling Temporal Data	**9**
Unit 4 Transaction Management and Recovery	
Introduction – Transaction Processing – Enhanced Lock Based Protocol – Timestamp Based Protocol: Multiple Granularity – Multi Version Schemas: Multi Version Timestamp Ordering – Multi Version Two Phase Locking – Weak Levels of Consistency – Concurrency in Index Structures – Failure Classification – Recovery Algorithms – Buffer Management – Advanced Recovery Techniques – Remote Backup Systems	**9**
Unit 5 Database Security and Authorization	
Introduction – Database Security: Scenario – Levels of Database Security: Server Security – Database Connections – Table Access Control – Restricting Database Access – Access Control: Granting permissions – Removing permissions – Statistical Database Security – Multilevel Security – Audit trails in Database – Vendor Specific E-security	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Understand the fundamental Concepts of Database

CO2 : Learn about Query Processing and Evaluation

CO3 : Know & Discuss Relational Database Design

CO4 : Understand the concept of Transaction and Analyze the Algorithms to give Recovery Techniques

CO5 : Understand the High Levels of Data Security & Access Control

CO PO MAPPING

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

REFERENCE BOOKS:

1. Hector-Garcia Molina, Jeffery D.Ullman, Jenifer Wisdom, "Database System – The Complete Book" Standford University, Pearson Prentice Hill,2nd Edition
2. Dr.Radyanbi Tibor "Advanced Database Management Systems" Tartalom Publication
3. Silberschatz, Korth and Sudarshan "Database System Concepts"7th Edition
4. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
5. Jef Van Loon "Database Security Concepts and Challenges" Pearson,5th Edition

CS624202: Web Engineering					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To describe the concepts of WWW including browser and HTTP protocol.
- List the various HTML tags and use them to develop the user-friendly web pages.
- To Define the CSS with its types and use them to provide the styles to the web pages at various levels
- Use the JavaScript to develop the dynamic web pages.
- Use server side scripting with PHP to generate the web pages dynamically using the database connectivity

Unit 1 Introduction and Web Design	
Concept of WWW, Internet and WWW, HTTP Protocol : Request and Response, Web browser and Web servers, Features of Web 2.0, Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation	**9**
Unit 2 HTML and Style sheets	
Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of HTML5, Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties ,manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3	**9**
Unit 3 JavaScript	
Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web	**9**
Unit 4 XML and AJAX	
Introduction to XML, uses of XML, simple XML, and XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT, AJAX Introduction, XMLHttp, Request, and Response, Form Validation	**9**
Unit 5 PHP	
Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1 : Describe the concepts of WWW including browser and HTTP protocol
CO2 : List the various HTML tags and use them to develop the user-friendly web pages
CO3 : Define the CSS with its types and use them to provide the styles to the web pages at various levels

CO4 : Develop the modern web pages using the HTML and CSS features with different layouts as per need of applications

CO5 : Use server side scripting with PHP to generate the web pages dynamically using the database connectivity

CO PO MAPPING

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

REFERENCE BOOKS:

1. Jeffrey C. Jackson, “Web Technologies-A Computer Science Perspective", Pearson Education, 2012
2. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India
3. Web Technologies, Black Book, dream tech Press

CS624203: Artificial Intelligence					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To gain knowledge about the basics of artificial intelligence.
- To understand the basics of Problem solving problems.
- To understand about the knowledge representation
- To learn about the features of intelligent agents.
- To learn about the details of applications of AI

Unit 1 Introduction	
Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems	**9**
Unit 2 Problem Solving methods	
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games	**9**
Unit 3 Knowledge Representation	
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information	**9**
Unit 4 Software Agents	
Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems	**9**
Unit 5 Applications	
AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1 : Know the basics of Artificial intelligence
CO2 : Know the concepts of problem Solving methods
CO3 : Learn the concept of Knowledge Representation in AI
CO4 : Understand the characteristics of Software agents
CO5 : analyze about the applications of AI

CO PO MAPPING

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

REFERENCE BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009
2. I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011
3. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008
4. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009

CS624204: Service Oriented Architecture					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To gain understanding of the basic principles of service orientation
- To learn service oriented analysis techniques
- To learn technology underlying the service design
- To learn advanced concepts such as service composition, orchestration and Choreography
- To know about various WS specification standards

Unit 1 INTRODUCTION AND SOA	
Roots of SOA – Characteristics of SOA - Comparing SOA to client - server and distributed internet architectures –Anatomy of SOA - How components in an SOA interrelate - Principles of service orientation	**9**
Unit 2 WEB SERVICES	
Web services–Service descriptions–Messaging with SOAP–Message exchange Patterns– Coordination–Atomic Transactions–Business activities–Orchestration–Choreography-Service layer abstraction–Application Service Layer–Business Service Layer–Orchestration Service Layer	**9**
Unit 3 APPLICATION SERVICES	
Service oriented analysis–Business-centric SOA–Deriving business services-service modeling Service Oriented Design–WSDL basics–SOAP basics–SOA composition guidelines–Entity centric business service design–Application service design–Task-centric business service design Software as a System (SaaS), SOA in cloud computing	**9**
Unit 4 WEB SERVICE ORIENTED LANGUAGES	
SOA platform basics–SOA support in J2EE–Java API for XML-based web services (JAX-WS)- Java architecture for XML binding (JAXB)–Java API for XML Registries (JAXR)-Java API for XML based RPC (JAX-RPC) Common Language Runtime-ASP.NET web forms–ASP.NET web services–Web Services Enhancements (WSE)	**9**
Unit 5 WEB SECURITY	
Web Security: BPEL basics–Coordination overview-Choreography, Policy, Security – Addressing Language basics – Reliable messaging Language basics – The Nack Element – The ACK Request Element – Other Reliable messaging Elements-WS-Security Language basics – Terminology, message protection mechanism, Tokens, Signature, Encryption, Timestamp	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Gain knowledge on basic concepts of SOA and it differs with other architectures

CO2 : Understand the knowledge on advanced concepts of service composition, Orchestration and Choreography. Understanding of web service framework with respect to SOA

CO3 : Learn various service oriented analysis techniques. Understand the technology underlying the service design

CO4 : Gain knowledge on creation of SOA compliant web service using various technologies

and acquire hands-on experience on the same

CO5 : Gain knowledge on various open standards available for developing SOA compliant web services

CO PO MAPPING

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

REFERENCE BOOKS:

1. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education ,Second Edition, 2011.
2. Thomas Erl, "SOA Principles of Service Design "(The Prentice Hall Service-Oriented Computing Series from Thomas Erl), 2005
3. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005

CS624205: Information Storage Management					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

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

Unit 1 STORAGE TECHNOLOGY	
Review data creation - Amount of data being created - Understand the value of data to a business - Challenges in data storage and data management -Solutions available for data storage - Core elements of a data center infrastructure - Role of each element in supporting business activities	**9**
Unit 2 STORAGE SYSTEM ARCHITECTURE	
Hardware and software components of the host environment - Key protocols and concepts used by each component - Physical and logical components of a connectivity environment - Major physical components of a disk drive and their function - Logical constructs of a physical disk - Access characteristics - Performance Implications - Concept of RAID and its components – Different RAID levels and their suitability for different application environments - Compare and contrast integrated and modular storage systems - High-level architecture and working of an intelligent storage system	**9**
Unit 3 INTRODUCTION TO NETWORKED STORAGE	
Evolution of networked storage - Architecture - Components - Topologies ofFC-SAN - NAS - IP-SAN - Benefits of the different networked storage options -Understand the need for long-Term archiving solutions - Describe how CASfullfill the need - Understand the appropriateness - Different networked storage options - Different application environments	**9**
Unit 4 INFORMATION AVAILABILITY, MONITORING & MANAGING DATA CENTERS	
List reasons for planned or unplanned outages - Impact of downtime -Business continuity (BC) - Disaster recovery (DR) - RTO - RPO - Identify single points of failure - List solutions to mitigate failures - Architecture of backup / recovery - Different backup or recovery topologies – Replication technologies - Role in ensuring information availability and business continuity - Remote replication technologies - Role in providing disaster recovery and business continuity capabilities - Identify key areas to monitor in a data center - Industry standards for data center monitoring and management - Key metrics - Key management tasks	**9**
Unit 5 SECURING STORAGE AND STORAGE VIRTUALIZATION	
Information security - Critical security attributes - Storage security domains -List and analyze the common threats in each domain – Virtualization technologies - Block-level and file-level virtualization technologies and processes	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Understand the basics of storage management for Information maintenance

CO2 : Understand the requirements and strategies for the data center

CO3 : Identify the storage technologies for the required application

CO4 : Understand the security measures to data center

CO5 : Understand the Quality of Service needed in Storage

CO PO MAPPING

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

REFERENCE BOOKS:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2012
2. Marc Farley, “Building Storage Networks”, Tata McGraw Hill” ,Osborne, 2001
3. Robert Spalding, “Storage Networks: The Complete Reference”, Tata McGraw Hill , Osborne, 2003

PROGRAMME
ELECTIVE -II [SEM-II]

CS624206: Internet of Things					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To identify the components of IoT.
- To analyze various protocols of IoT.
- To design portable IoT using appropriate boards.
- To design business Intelligence and Information Security for WoT.
- To develop schemes for the applications of IOT in real time scenarios

Unit 1 Introduction to IoT	
Internet of Things-Components-Physical and Logical Design-IoT Enabling Technologies-IoT Deployment Templates- IoT Domains-IoT and M2M-IoT Platforms and Design Management	**9**
Unit 2 IoT Architectures	
M2M High-level ETSI architecture-IETF Architecture for IoT-OGC Architecture-IoT Reference Model-Domain Model-Information Model-Functional Model-Communication Model-IoT Sample Architectures	**9**
Unit 3 IoT Protocols	
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	**9**
Unit 4 Building IoT using Raspberry Pi and Arduino	
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	**9**
Unit 5 Case Studies and Practices	
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	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1 : Explain the significance of the components of IoT
CO2 : Explain the various protocols of IoT
CO3 : Describe the roles of portable IoT using appropriate boards
CO4 : Compare the performance of business Intelligence and Information Security for WoT
CO5 : Explain schemes for the applications of IOT in real time scenarios

CO PO MAPPING

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

REFERENCE BOOKS:

1. HonboZhou,"The Internet of Things in the Cloud: A Middleware Perspective" - CRC Press 2012
2. Luigi Atzori, Antonio Lera, Giacomo Morabito, "The Internet of Things: A Survey", Journal on Networks, Elsevier Publications, October, 2010
3. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012

CS624207: Big Data Analytics						
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- To Understand the fundamental Concepts of Big data.
- To Analyze the Clustering and Classification Techniques.
- To learn about the Applications of Association Rules.
- To Apply the Stream Concepts Using Graph Analytics for Big Data.
- To Create the Hbase Using the NOSQL Concepts.

Unit 1 Introduction to Big data	
Evolution of Big data – Best Practices for Big Data Analytics – Big data characteristics – Validating – The Promotion of the Value of Big Data – Big Data Use Cases- Characteristics of Big Data Applications – Perception and Quantification of Value -Understanding Big Data Storage – A General Overview of High-Performance Architecture – HDFS – Map Reduce and YARN – Map Reduce Programming Model	**9**
Unit 2 Clustering and Classification	
Advanced Analytical Theory and Methods: Overview of Clustering – K-means – Use Cases – Overview of the Method – Determining the Number of Clusters – Diagnostics – Reasons to Choose and Cautions. - Classification: Decision Trees – Overview of a Decision Tree – The General Algorithm – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Trees in R – Naïve Bayes – Bayes 'Theorem – Naïve Bayes Classifier.	**9**
Unit 3 Association and Recommendation	
Advanced Analytical Theory and Methods: Association Rules – Overview – Apriori Algorithm – Evaluation of Candidate Rules – Applications of Association Rules – Finding Association & finding similarity – Recommendation System: Collaborative Recommendation- Content Based Recommendation – Knowledge Based Recommendation- Hybrid Recommendation Approaches.	**9**
Unit 4 Stream Memory	
Introduction to Streams Concepts – Stream Data Model and Architecture – Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics	**9**
Unit 5 No SQL Data Management for big data and Visualization	
NoSQL Databases: Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores – Tabular Stores – Object Data Stores – Graph Databases Hive – Sharding –-Hbase – Analyzing big data with twitter – Big data for E-Commerce Big data for blogs – Review of Basic Data Analytic Methods using R.	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Understand the fundamental Concepts of Big data

CO2 : Analyze data by utilizing clustering and classifications algorithm

CO3 : Learn and apply different mining algorithms and recommendation systems for large volumes of data

CO4 : Perform Analytics on data streams

CO5 : Learn NoSQL Databases and Management

CO PO MAPPING

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

REFERENCE BOOKS:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015
4. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015

CS624208: Mobile and Pervasive Computing						
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- To understand the fundamental concepts of mobile computing
- To know about Emerging technologies
- To learn about GPRS and its application
- To know about mobile adaptive computing and data dissemination management
- To provide an introduction about mobile middleware

Unit 1 INTRODUCTION	
Introduction: - Mobile Computing - Middleware And Gateways - Applications And Services – Developing Mobile Applications –Blue tooth, WiFi, WiMAX, 3G,WATM.- Mobile IP protocols-Mobile computing Architecture: Internet-the Ubiquitous network - Architecture For Mobile Computing - Three Tier Architecture - Design considerations for Mobile Computing – Mobile Computing through Internet	**9**
Unit 2 EMERGING TECHNOLOGIES AND GSM COMMUNICATION	
Emerging Technologies: Radio Frequency Identification (RFID) - Wireless Broadband (Wimax) - Mobile IP -Internet Protocol Version 6(IPv6). Global System For Mobile Communications (GSM): Global System For Mobile Communications - GSM Architecture - GSM Entities - Call Routing in GSM –PLMN Interfaces- GSM Addresses and Identifiers – Network Aspects in GSM – Mobility Management – GSM Frequency Allocation – Personal Communication Service – Authentication and Security	**9**
Unit 3 GPRS, CDMA AND 3G COMMUNICATIONS	
General Packet Radio Service: GPRS network architecture- GPRS network operations - Data services in GPRS - Applications - Limitations – Billing and Charging – EDGE – Wireless Application Protocol – CDMA and 3G: Introduction – CDMA versus GSM – Wireless Data –Third generation networks – Applications on 3G	**9**
Unit 4 MOBILE ADAPTIVE COMPUTING & DATA DISSEMINATION MANAGEMENT	
Mechanisms for Adaptation – How to develop adaptations in applications – Support for building adaptive mobile applications - Mobility Management: Location Management Principles and Techniques – Location management case studies - Data Dissemination and Management: Challenges – Data Dissemination – Mobile Data Caching – Mobile Cache Maintenance schemes – Mobile Web Caching	**9**
Unit 5 PERVASIVE COMPUTING AND MOBILE MIDDLEWARE	
Ubiquitous or Pervasive computing –Context: definitions - types of contexts – Context-aware computing and applications – middleware support - Mobile middleware – Adaptation – Agents – Service discovery – Middleware for application development: Adaptation and Agents-Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context- Driven HCI Service Selection	**9**

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : outline the basic problems, performance requirements of pervasive computing applications, and the trends of pervasive computing and its impacts on future computing applications and society

CO2 : understand about various recent and emerging technologies

CO3 : outline the basics of GPRS and its applications

CO4 : develop an attitude to propose solutions with comparisons for problems related to pervasive computing system through investigation

CO5 : understand middleware applications

CO PO MAPPING

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

REFERENCE BOOKS:

1. AsokeK.Talukder, Hasan Ahmed, Rooba. R. Yavagal, "Mobile Computing Technology, Applications and Service Creation", Second Edition, Tata McGraw Hill, 2010
2. Frank Adelstein, Sandeep K.S Gupta , Golden G. Richard III, Loren Schwiebert - Fundamentals of Mobile and Pervasive Computing, Tata McGraw-Hill Education Private Limited, Seventh reprint, 2010
3. JochenSchiller,"Mobile Computing, Wireless Transmission Approach and its Applications", Second Edition, Pearson Education, 2011
4. Pattnaik, Prasant Kumar, RajibMall,"Fundamentals of Mobile Computing", Eastern Economy Edition, PHI Learning Private Limited, 2012
5. JochenBurkhardt, Pervasive Computing: Technology and Architecture of Mobile Internet Applications, Addison-Wesley Professional; 3rd edition, 2007

CS624209: Software Reliability and Metrics						
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	

COURSE OBJECTIVES:

- Learn different definitions of software quality
- Know different notions of defects and classify them
- Understand the basic techniques of data collection and how to apply them
- Learn software metrics that define relevant metrics in a rigorous way.
- Gain confidence in ultra-high reliability.

Unit 1 INTRODUCTION TO SOFTWARE RELIABILITY	
Basic Concepts – Failure and Faults – Environment – Availability –Modeling –uses – requirements reliability metrics – design & code reliability metrics – testing reliability metrics	**9**
Unit 2 COMPARISON OF SOFTWARE RELIABILITY MODELS	
Concepts – General Model Characteristic – Historical Development of models – Model Classification scheme – Markovian models – General concepts – General Poisson Type Models – Binomial Type Models – Poisson Type models – Fault reduction factor for Poisson Type models	**9**
Unit 3 COMPARISON OF SOFTWARE RELIABILITY MODELS	
Comparison Criteria – Failure Data – Comparison of Predictive Validity of Model Groups – Recommended Models – Comparison of Time Domains – Calendar Time Modeling – Limiting Resource Concept – Resource Usage model – Resource Utilization – Calendar Time Estimation and confidence Intervals	**9**
Unit 4 FUNDAMENTALS OF MEASUREMENT	
Measurements in Software Engineering – Scope of Software metrics – Measurements theory – Goal based Framework – Software Measurement Validation	**9**
Unit 5 MEASURING SOFTWARE PRODUCT	
Measurement of Internal Product Attributes – Size and Structure – External Product Attributes – Measurement of Quality – Software Reliability: Measurement and Prediction	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Understand basic concepts of software reliability

CO2 : Perform some simple statistical analysis relevant to software measurement data

CO3 : Use from practical examples both the benefits and limitations of software metrics for quality control and assurance

CO PO MAPPING

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

REFERENCE BOOKS:
1. John D. Musa, ―Software Reliability Engineering‖, Tata McGraw Hill, 1999
2. John D. Musa, Anthony Iannino, KazuhiraOkumoto, ―Software Reliability – Measurement, Prediction, Application, Series in Software Engineering and Technology‖, McGraw Hill, 1987
3. Norman Fenton, James Bieman, ―Software Metrics: A Rigorous and Practical Approach‖, 3rd edition, CRC Press, 2015 25 IF5191 AD

CS624210: Fuzzy logic and its Applications					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To know about the basics of Fuzzy logic.
- To understand the basics concept of Fuzzy systems.
- To understand about the principles of Fuzzy set theory.
- To study about the features of Fuzzy logic for modeling.
- To know about the details of applications of Fuzzy Logic

Unit 1 INTRODUCTION TO FUZZY LOGIC PRINCIPLES	
Basic concepts of fuzzy set theory – operations of fuzzy sets – properties of fuzzy sets – Crisp relations – Fuzzy relational equations – operations on fuzzy relations – fuzzy systems – propositional logic – Inference – Predicate Logic — fuzzy logic principles – – fuzzy inference – fuzzy rule based systems – fuzzification and defuzzification – types	**9**
Unit 2 FUZZY SYSTEMS	
Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making	**9**
Unit 3 FUZZY SET THEORY	
Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions	**9**
Unit 4 FUZZY LOGIC FOR MODELING AND CONTROL	
Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox	**9**
Unit 5 FUZZY LOGIC APPLICATIONS	
Fuzzy logic controllers – principles – review of control systems theory – various industrial applications of FLC adaptive fuzzy systems – fuzzy decision making – Multiobjective decision making – fuzzy classification – means clustering – fuzzy pattern recognition – image processing applications	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : know the basics principles of Fuzzy Logic

CO2 : know and study the concepts of Fuzzy systems

CO3 : Understand the concept of Fuzzy sets and its relations

CO4 : To learn the importance of modeling in Fuzzy logic

CO5 : Analyze about the fuzzy logic applications

CO PO MAPPING

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

REFERENCE BOOKS:

1. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 2000
3. Zhang Huaguang and Liu Derong, “Fuzzy Modeling and Fuzzy Control Series: Control Engineering”, 2006
4. Klir.G, Yuan B.B. “Fuzzy sets and Fuzzy Logic”, Prentice Hall of India private limited, 1997
5. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1996

PROGRAMME
ELECTIVE -III [SEM-II]

CS624211: Software Quality Assurance and Testing					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

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

Unit 1 SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES	
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	**9**
Unit 2 SYSTEM TESTING	
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. Builtin 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	**9**
Unit 3 SYSTEM TEST CATEGORIES	
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	**9**
Unit 4 SOFTWARE QUALITY	
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	**9**
Unit 5 SOFTWARE QUALITY ASSURANCE	
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.	**9**

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

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Perform functional and non-functional tests in the life cycle of the software product

CO2 : Understand system testing and test execution process

CO3 : Identify defect prevention techniques and software quality assurance metrics

CO4 : Apply techniques of quality assurance for typical applications

CO5 : Analyze the Quality of Software

CO PO MAPPING

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

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, MilindLimaye, TMH ,New Delhi, 2011

CS624212 – Cognitive Computing					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To appreciate the need of Cognitive Computing Techniques.
- To learn different types of sets which can handle imprecise data values
- To develop systems which have learning capabilities.
- To learn techniques to optimize the results and find the optima

Unit 1 Psychology and Neuroscience	
Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn – The Philosophy of Science – The Mind in Cognitive Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science -Science of Information Processing – Neurosciences: Cognitive Neuroscience – Perception -Decision – Learning and Memory – Language Understanding and Processing	**9**
Unit 2 Probabilistic Programming Language	
Web PPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations -Enumeration – Other basic computation	**9**
Unit 3 Fuzzy sets and fuzzy logic	
Introduction to fuzzy logic, classical and fuzzy sets, overview of fuzzy sets, membership function, fuzzy rule generation, operations on fuzzy sets: compliment, intersection, union, combinations on operations, aggregation operation. Fuzzy Extension Principles, Defuzzification. Fuzzy Rule bases, Development of Fuzzy Logic based Expert Systems. CASE STUDIES	**9**
Unit 4 Neural Networks &Rough Sets	
Overview of biological neurons, Mathematical model of Neuron, Perceptron and Multi Layer Perceptron, Learning in Artificial Neural Networks; Supervised, Unsupervised and Competitive Learning paradigms; Learning rules and Functions, Back propagation algorithm, Rough Sets. Upper and Lower Approximations, Boundary Region, Decision Tables and Decision Algorithms. Properties of Rough Sets. Rough Membership, Reducts. Discernibility Matrix and Discernibility Functions. Generation of Inference Rules	**9**
Unit 5 Evolutionary Algorithms and Hybrid Algorithms	
Introduction, Evolutionary algorithms - Genetic Algorithm: History, terminology, biological background, creation of offspring, working principles of genetic algorithms, fitness function, Roulette wheel selection, Boltzmann selection, cross over mutation, inversion, deletion, and duplication, generation cycle , Swarm Optimization –Part Swarm Optimization and Ant Colony Optimization. Differential Evolutionary Algorithm	**9**
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Understand the Philosophy of Science

CO2 : Able to realize importance and apply Computing techniques for real world problem solving

CO3 : Able to represent the imprecise information using sets and develop inference systems based on these

CO4 : Develop learning systems

CO5 : Learn and practice various optimization algorithms for real world problems solving

CO PO MAPPING

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

REFERENCE BOOKS:

1. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences", The MIT Press, 1999
2. Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/
3. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org

CS624213: SOCIAL NETWORK ANALYSIS					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Gain knowledge about the current Web development and emergence of Social Web
- Study about the modeling, aggregating
- Learn knowledge representation of Semantic Web
- Learn about the extraction and mining tools for Social networks
- Gain knowledge on Web personalization and Web Visualization of Social networks

Unit 1INTRODUCTION TO SOCIAL NETWORK ANALYSIS	
Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis - Electronic discussion networks, Blogs and online communities	**9**
Unit 2 MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION	
Ontology and their role in the Semantic Web - Ontology-based Knowledge Representation - Ontology languages for the Semantic Web – RDF and OWL - Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data, Advanced Representations	**9**
Unit 3 EXTRACTION AND MINING COMMUNITITES IN WEB SOCIAL NETWORKS	
Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Definition of Community - Evaluating Communities - Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Tools for Detecting Communities Social Network Infrastructures and Communities	**9**
Unit 4 PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES	
Understanding and Predicting Human Behaviour for Social Communities - User Data Management, Inference and Distribution - Enabling New Human Experiences - Reality Mining - Context-Awareness - Privacy in Online Social Networks - Trust in Online Environment - Trust Models Based on Subjective Logic - Trust Network Analysis - Combining Trust and Reputation	**9**
Unit 5 VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS	
Graph Theory- Centrality- Clustering - Node-Edge Diagrams, Matrix representation, Visualizing Online Social Networks, Visualizing Social Networks with Matrix-Based Representations- Matrix + Node-Link Diagrams, Hybrid Representations - Applications - Covert Networks - Community Welfare - Collaboration Networks - CoCitation Networks	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Apply knowledge for current Web development in the era of Social Web

CO2 : Model, aggregate and represent knowledge for Semantic Web

CO3 : Design extraction and mining tools for Social networks

CO4 : Develop personalized web sites and visualization for Social networks

CO5 : Design Web personalization and Visualization for Social networks

CO PO MAPPING

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

REFERENCE BOOKS:

1. Peter Mika, ―Social Networks and the Semantic Web‖, First Edition, Springer 2007
2. BorkoFurht, ―Handbook of Social Network Technologies and Applications‖, 1st Edition, Springer, 2010
3. Peter Mika, ―Social networks and the Semantic Web‖, Springer, 1st edition 2007
4. Dion Goh and Schubert Foo, ―Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008

CS624214: Data Mining Techniques					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
Analyze various data mining tasks to find relevant patterns from large databases					
Unit 1 Introduction					
Introduction: Challenges, The Origins of Data Mining, Data Mining Tasks **Data:** Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity, OLAP and Multidimensional Data Analysis					**9**
Unit 2 Basic of Classification					
Classification: Preliminaries, General Approach to Solving a Classification Problem, Decision Tree Induction, Model Overfitting, Evaluating the Performance of a Classifier, Methods for Comparing Classifiers, Rule-Based Classifier					**9**
Unit 3 Classification techniques					
Nearest-Neighbor classifiers, Bayesian Classifiers, Artificial Neural Networks (ANN), Support Vector Machine (SVM), Ensemble Methods, Class Imbalance Problem, Multiclass Problem					**9**
Unit 4 Association Analysis					
Problem Definition, Frequent Itemset Generation, Rule Generation, Compact Representation of Frequent Itemsets, Alternative Methods for Generating Frequent Itemsets, FP-Growth Algorithm, Evaluation of Association Patterns, Effect of Skewed Support Distribution, Handling Categorical Attributes, Handling Continuous Attributes, Handling a Concept Hierarchy					**9**
Unit 5 Cluster Analysis					
Overview, K-means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Characteristics of Data, Clusters and Clustering Algorithms					**9**
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1 : Explain the steps in KDD , Identify various pre-processing techniques and Compute similarity among objects and differentiate relational & multidimensional data models					
CO2 : Identify a classification model to classify unknown data objects based on different classification techniques					
CO3 : Illustrate the use of advanced classification models for prediction					
CO4 : Find associations and correlations among items by mining frequent patterns from transactional databases					
CO5 : Evaluate clusters formed based on various clustering techniques					

CO PO MAPPING

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

REFERENCE BOOKS:

1. Pang-Ning Tan, Vipin Kumar, Michael Steinbach, ”Introduction to Data Mining”, (2017),Pearson Education
2. Jiawei Han &MichelineKamber and Jain Pei ,Data Mining Concepts and Techniques , Third Edition(2011), India
3. Margaret H Dunham, Data Mining Introductory and advanced topics , Pearson education
4. Arun K Pujari ,Data Mining Techniques, (2017) ,University Press
5. Sam Anahory , Dennis Murray ,Data Warehousing in the Real World, Pearson Education
6. PaulrajPonnaiah, Data Warehousing Fundamentals, Wiley Student ed.
7. http://web.stanford.edu/class/cs345a/

CS624215: Block Chain Technologies					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To learn the various cryptography primitives used in block chain.
- To study the design principles of block chain.
- To understand the various consensus algorithms.
- To study the block chain in networking.
- To learn the enhancements of block chain technologies

Unit 1 CRYPTOGRAPHY IN BLOCKCHAIN	
Blockchain Definitions – Blockchain versus Databases – History – Motivation – Characteristics – Types – Overview - Hashing in Blockchain – Linking blocks in blockchain – Linking blocks using SHA256 – Block structure – Blockchain functionality – Creating Blockchain – Byzantine failure problem in blockchain – Digital signatures in blockchain – Blockchain wallets	**9**
Unit 2 BLOCKCHAIN DESIGN PRINCIPLES	
Networked Integrity – Distributed Power- Value as Incentive – Security – Privacy – Rights Preserved – Inclusion – Centralized Registries versus Distributed Ledgers – Public versus Private Ledgers – Transparency as a Strategic Risk – Transparency as a Strategic Asset - Zero Knowledge Proofs	**9**
Unit 3 CONSENSUS ALGORITHMS	
Proof of Work – Pure Stake Based Consensus – Proof of Stake - Leased Proof of Stake – Delegated Proof of Stake – Hybrid Form of PoS and PoW – Practical Byzantine Fault Tolerance – Ripple –Tendermint – Proof of Elapsed Time – Proof of Activity – Proof of Burn – Hyperledger Fabric	**9**
Unit 4 NETWORKING IN BLOCK CHAIN	
Peer – to –peer Networking – Network Discovery – Block Synchronization – Building a simple Blockchain in P2P Network – Validating new Block – Selecting Longest chain – Block Exchange between Peers – Application InterfacesBlockchain Networks – Testnet – Regtest – Blockchain in 5G – Blockchain in Social Networking – Blockchain for IoT	**9**
Unit 5 BLOCKCHAIN OPTIMIZATIONS AND ENHANCEMENTS	
Blockchain Optimizations – Transaction Exchange – Off-chain Transactions – Block size improvements – Blockchain enhancements – Sharding – Evolution of consensus algorithm – Proof of Stake – Proof of Activity – Byzantine Fault Tolerance Consensus Models – Proof of Elapsed Time – Cross-chain Protocol – Privacy Enhancement – Blockchain Security – Transaction Security Model – Decentralized Security Model – Attacks on Blockchain	**9**
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Implement the required cryptography primitives for block chain systems

CO2 : Work with various block chain design principles

CO3 : Implement with various consensus algorithms

CO4 : Equip networks with the various block chain techniques

CO5 : Work with block chain optimization techniques

CO PO MAPPING

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

REFERENCE BOOKS:

1. Koshik Raj, "Foundations of Blockchain", Packt Publishers, 2019
2. S. Shukla, M. Dhawan, S. Sharma and S. Venkatesan, "Blockchain Technology: Cryptocurrency and Applications", Oxford University Press, 2019
3. Josh Thompson, "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming", Create Space Independent Publishing Platform, 2017
4. Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", Oreilly Media, 1st Edition, 2014

PROGRAMME ELECTIVE - IV

CS624216 - **Agent Based Systems**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To define the algorithmic foundation of agents and multi agent systems.
- To explain theoretical foundations of agent based system.
- To apply Bayesian networks for probabilistic reasoning.
- To create logical agents to do inference using first order logic.
- To understand the higher level Agents concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: INTRODUCTION	**9**
Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching - Heuristics -Constraint Satisfaction Problems - Game playing.	
UNIT 2: KNOWLEDGE REPRESENTATION	**9**
Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events.	
UNIT 3: PLANNING PROBLEMS	**9**
Planning Problem-State Space Search-Partial Order Planning-Graphs-Nondeterministic Domains-Conditional Planning-Continuous Planning-MultiAgent Planning.	
UNIT 4: AGENTS UNDER UNCERTAINTY	**9**
Acting under uncertainty – Probability Notation-Bayes Rule and use - Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions.	
UNIT 5: HIGHLEVEL AGENTS	**9**
Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars-Future of AI.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Define the algorithmic foundation of agents and multi agent systems.

CO2: Analyze the theoretical foundations of agent based system.

CO3: Apply Bayesian networks for probabilistic reasoning.

CO4: Create logical agents to do inference using first order logic.

CO5: Understand the higher level Agents

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:
1.Stuart Russell and Peter Norvig, “Artificial Intelligence - A Modern Approach”,2nd Edition, Prentice Hall, 2002
2. Michael Wooldridge, “An Introduction to Multi Agent System”, John Wiley, 2002.
3. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, AW, 1999.
WEB RESOURCES:
1.https://warwick.ac.uk/fac/sci/dcs/teaching/modules/cs404/
2.https://link.springer.com/chapter/10.1007/978-3-642-17625-8_1

CS624217 - **Machine Learning**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To learn the latest trends in machine learning
- To design appropriate machine learning algorithms for problem solving
- To Analyse the appropriate machine learning approaches for various types of problems concepts acquired over the 5Units of the subject for improved employ ability skills

UNIT 1: INTRODUCTION	**9**
Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.	
UNIT 2: NEURAL NETWORKS AND CENETIC ALGORITHMS	**9**
Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.	
UNIT 3: BAESIAN AND COMPUTATIONAL LEARNING	**9**
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.	
UNIT 4: INSTANT BASED LEARNING	**9**
K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.	
UNIT 5: REGRESSION AND TREE BASED MODELS	**9**
Linear Regression - Multivariate Regression- Logistic Regression- Principal Component Regression- Decision Trees- Regression Trees.	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Differentiate between supervised, unsupervised, semi-supervised machine learning approaches

CO2: Discuss the decision tree algorithm and identity and overcome the problem of over fitting

CO3: Discuss and apply the back propagation algorithm and genetic algorithms to various problems

CO4: Apply the Bayesian concepts to machine learning

CO5: Analyse and suggest appropriate machine learning approaches for various types of problems

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

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

2.Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.

3.Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

WEB RESOURCES:

1.https://towardsdatascience.com/beginner-friendly-resources-for-machine-learning-fd198f844dc3

2.https://www.mltut.com/best-resources-to-learn-machine-learning-online/

CS624218 - **Android Application Development**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To know the system requirements for mobile applications
- To generate suitable design using specific mobile development frameworks
- To generate mobile application design
- To implement the design using specific mobile development frameworks
- To deploy the mobile applications in marketplace for distribution concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: INTRODUCTION TO MOBILE APPLICATIONS	**9**
Web Vs mobile App – Cost of Development – Myths - Mobile Applications – Marketing - Mobile User Interface Design - Effective Use of Screen – Mobile Users - Mobile Information Design - Mobile Platforms - Tools of Mobile Interface Design**.**	
UNIT 2: ANDROID USER INTERFACE DESIGN	**9**
Android Architecture – Android SDK Tools - Application Components - Intents - Content providers - Broadcast receivers – Services - User Interface Design - Views - View Groups – Layouts - Event Handling – Listeners – Adapters – Menus - Action Bars – Notifications - Android Localization.	
UNIT 3: ANDROID DATA STORAGE	**9**
Content Providers – Uri - CRUD access –Browser – CallLog – Contacts – Media Store - Data Access and Storage - Shared Preferences - Storage External - Network Connection - SQLite Databases.	
UNIT 4: ANDROID NATIVE CAPABILITIES	**9**
Camera – Audio - Sensors and Bluetooth - Playing audio/video - Media recording - Sensors - Listening to sensor readings – Bluetooth - Android Communications – GPS - Working with Location Manager, Working with Google Maps extensions - Maps via intent - Map Activity - Location based Services - Location Updates - Location Providers - Selecting a Location Provider - Finding Location.	
UNIT 5: IOS DESIGN	**9**
iPhone Craze – iOS Features – iOS Tools - iOS Project – Objective C Basics – Building iOS App – Actions and Outlets – Delegates - User Interface Elements – Accelerometer – Location Handling - SQLite Database	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe the requirements for mobile applications

CO2: Design user interface for mobile applications

CO3: Store mobile data of android applications

CO4: Evaluate native capabilities of android applications

CO5: Design iOS applications with tools

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1.Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012

2.Reto Meier, "Professional Android 4 Development", John Wiley and Sons, 2012

3.David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.

WEB RESOURCES:

1.https://developer.android.com/studio/write/app-link-indexing

2.https://developer.android.com/guide/topics/resources/available-resources

CS624219 - **Soft Computing Techniques**					
Course Category: Program Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms
- To apply soft computing techniques to solve problems.
- To learn the Genetic Algorithms
- To design the hybrid System concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: INTRODUCTION TO SOFT COMPUTING	**9**

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-Mc-Culloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT 2: ARTIFICIAL NEURAL NETWORKS	**9**

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT 3: FUZZY SYSTEMS	**9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT 4: GENETIC ALGORITHM	**9**

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.

UNIT 5: HYBRID SYSTEMS	**9**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP-Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Apply suitable soft computing techniques for various applications.

CO2: Integrate various soft computing techniques for complex problems.

CO3: Apply soft computing techniques by using Fuzzy algorithms to solve problems.

CO4: Apply soft computing techniques by using Genetic algorithmsto solve problems.

CO5: Design the hybrid System

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1.N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.

2.S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.

3.S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

WEB RESOURCES:

1.https://link.springer.com/chapter/10.1007/978-3-030-75657-4_9

2.https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html

CS624220 - **Bio-informatics**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To improve the programming skills of the student
- To let the students know the recent evolution in biological science
- To pursue higher education in this field.
- To practice life-long learning of applied biological science.
- To analyze the Perl Programming concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: NTRODUCTION	**9**

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT 2: SEQUENCE ALIGNMENT	**9**

Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT 3: PHYLOGENETIC METHODS	**9**

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT 4: PROTEIN STRUCTURE ANALYSIS	**9**

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

UNIT 5: PERL PROGRAMMING	**9**

Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Develop bioinformatics tools with programming skills.

CO2: Apply computational based solutions for biological perspectives.

CO3: Pursue higher education in this field.

CO4: Practice life-long learning of applied biological science.

CO5: Analyse the Perl Programming

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1.A Textbook of BioinformaticInformation-theoretic Perspectives of Bioengineering and Biological Complexeshttps://doi.org/10.1142/11627 | September 2020

2.Bioinformatics, 4th Edition,Andreas D. Baxevanis (Editor), Gary D. Bader(Editor), David S. Wishart (Editor)ISBN: 978-1-119-33558-0 May 2020

3.A First Course In Computers 2003 Edition (With Cd) Paperback
by Sanjay Saxena (Author)

WEB RESOURCES:

1.https://guides.lib.berkeley.edu/bioinformatics

2.https://www.linkedin.com/pulse/bioinformatics-web-resources-ajit-roy

PROGRAMME
ELECTIVE - V

CS624221 - **Multimedia and Compression Techniques**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Know the basic ideas of compression algorithms related to multimedia components.
- To Learn the principles and standards of Text and Audio Compression Techniques.
- To introduce the principles and standards of Image and Video Compression Techniques.
- To analyze the use of the techniques in real-time applications.
- To Implement various applications using compression algorithms concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: FUNDAMENTALS OF COMPRESSION	**9**
Special features of multimedia-Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms– Error Free Compression – Lossy Compression.	
UNIT 2: TEXT COMPRESSION	**9**
Compression principles-source encoders and destination encoders- entropy encoding –source encoding- text compression –static Huffman coding dynamic Huffman coding –arithmetic coding – Lempel Ziv-Welsh Compression- Shannon Fano coding	
UNIT 3: AUDIO COMPRESSION	**9**
Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive codingcode excited LPC-perpetual coding. Audio compression Techniques – μ Law and A Law companding - Speech compression - Frequency domain and filtering – Basic subband coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio	
UNIT 4: IMAGE COMPRESSION	**9**
Image Compression: Fundamentals — Compression Standards – JPEG Standard –Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 Text Audio Image Multimedia Video Coding -Static Huffman -Dynamic Huffman -Dynamic Coding Standards -G.722 -MPEG Coding -APC -LPC -Perpetual Coding -Sub-Band Coding Coding -Sub-Band Coding -Lossless Coding -Hierarchial Coding Standards JPEG JPEG2000 JBIG JBIG2 -DVI Technology -Current Trends Standards MPEG1 MPEG2 MPEG3 MPEG4 standards – JBIG and JBIG2 standards.	
UNIT 5: VIDEO COMPRESSION	**9**
Video compression techniques and Standards–MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4–Motion estimation and compensation techniques–H.261 Standard – - DVI technology – DVI real time compression – Current Trends in compression standards.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the basic ideas of compression algorithms related to multimedia components

CO2: Understand the principles and standards of Text and Audio Compression Techniques

CO3: Understand the principles and standards of Image and Video Compression Techniques

CO4: Make use of the techniques in real-time applications

CO5: Implement various applications using compression algorithms

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1.Fred Halshall "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson Education, 2007.

2.KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007.

3.R.Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education Ranjan Parekh, "Principles of Multimedia", TMH 2007.

WEB RESOURCES:

1.https://www.dsengg.ac.in/ece/EC6018%20Multimedia%20Compression%20and%20Communication.pdf

2.https://ieeexplore.ieee.org/document/6205727

CS624222 - **Data Visualization Techniques**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: CORE SKILLS FOR VISUAL ANALYSIS	**9**

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT 2: TIME-SERIES, RANKING, AND DEVIATION ANALYSIS	**9**

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT 3: DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS	**9**

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT 4: INFORMATION DASHBOARD DESIGN	**9**

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT 5: INFORMATION DASHBOARD DESIGN	**9**

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Explain principles of visual perception

CO2: Apply core skills for visual analysis

CO3: Apply visualization techniques for various data analysis tasks

CO4: Design information dashboard

CO5: Understand visualization for deviation analysis.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1.Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

2.Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

3.Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.

WEB RESOURCES:

1.https://blog.hubspot.com/marketing/data-visualization-resources.

2.https://www.xenonstack.com/blog/data-visualization-techniques.

CS624223 - **Python with R program**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand basic elements of python and concepts on controlling program flow
- To solve problems by writing functions and using objects
- To explore fundamentals of bio python
- To handle data using R program
- To perform statistical analysis of biological data concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: ELEMENTS OF PYTHON PROGRAMMING **9**

Introduction to Python: source code, text editors, whitespace, syntax and syntax errors, Python versions – Lists: lists and arrays – Dictionaries: paired data types, hashing, key uniqueness, argument unpacking and tuples – Working with files: objects and classes, paths and folders, relationships between variables and values, text and binary files, newlines - Loops: blocks and indentation, variable scoping, iteration, ranges - Conditions:Truth and falsehood, Boolean logic, identity and equality, evaluation of statements, branching.

UNIT 2: PROBLEM SOLVING **9**

Comprehension: List and Dictionary - Writing functions: nuts and bolts of writing functions: argument passing, encapsulation, data flow through a program – Classes and objects: classes, instances, methods vs. functions, self, constructors, magic methods – Object-oriented programming: inheritance and class hierarchies,method overriding, super classes and sub classes, polymorphism, composition, multiple inheritances. Case study: Object representation of biological data: Defining features of a system (eg., organism) and using them to identify the organism.

UNIT 3: BIOPYTHON **9**

Python libraries: using standard modules and creating a new module; Biopython: introduction, installation,important components like seq, seqIO, alignIO, BLAST, ClustalW, PDB, SwissProt etc., parsing output.Case study: Use of python libraries for biological application: using BioSeq to change information content from DNA to RNA to protein

UNIT 4: R PROGRAMMING ESSENTIALS **9**

Fundamentals: Constants, operators, functions, variables, Random numbers, Vectors and vector indexing, Simple descriptive stats, Loops, Conditional expressions - Datatypes: Levels of measurement (nominal, ordinal, interval, ratio scale), Vector types, Characteristics of tidy data (missing values), data imputation,duplicates, outliers, spelling, Create new variables in a data.frame - Filter rows and columns - Merging datasets.

UNIT 5: STATISTICAL DATA ANALYSIS USING R **9**

Basic Statistics: mean, median, standard deviation, variance, correlation, covariance - Linear regression: simple linear regression, introduction to multiple linear regression - Classification: logistic regression, decision trees, SVM - Ensemble methods: bagging, random forests, boosting - Clustering: K-means, Hierarchicalclustering, X-means.Case study: Deployment of R in Biological data analysis: Statistical data analysis of field trial data for experimental significance.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Write programs handling data input and control the data flow

CO2: Solve simple problems using a program

CO3: Write python programs with inbuilt functions from bio python package

CO4: Solve analytic data using R program

CO5: Perform statistical analysis of biological data using R

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1.Jones, M. (2014), Advanced Python for Biologists. Create Space Independent Publishing Platform 1st edition,ISBN: 978-1495244377

2.Downey A. B. (2012), Think Python O'Reilly Media 1 edition ISBN: 978-1449330729

3.MacLean, D., R Bioinformatics Cookbook: Use R and Bioconductor to perform RNAseq, genomics, data visualization, and bioinformatic analysis, Packt Publishing, ISBN: 978-1789950694

WEB RESOURCES:

1.https://posit.co/blog/three-ways-to-program-in-python-with-rstudio/

2.https://exeter-data-analytics.github.io/python-data/scraping.html

CS624224 -**Formal Model and Software Systems**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
- To understand the fundamentals of abstraction and formal systems
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- To understand formal specification models based on set theory, calculus and algebra and apply to a case study
- To learn Z, Object Z and B Specification languages with case studies concepts acquired over the 5Units of the subject for improved employability skills

UNIT 1: SPECIFICATION FUNDAMENTALS	**9**

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

UNIT 2: FORMAL METHODS	**9**

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction. Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency. Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control.

UNIT 3: LOGIC	**9**

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

UNIT 4: SPECIFICATION MODELS	**9**

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

UNIT 5: FORMAL LANGUAGES	**9**

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions,

Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.

CO2:Gain knowledge on fundamentals of abstraction and formal systems

CO3:Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems

CO4:Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study

CO5:Have working knowledge on Z, Object Z and B Specification languages with case studies.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1. Mathematical Logic for computer science ,second edition, M.Ben-Ari ,Springer,2003.

2.Logic in Computer Science- modeling and reasoning about systems, 2 nd Edition, Cambridge University Press, 2004.

3.The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press,1996.

WEB RESOURCES:

1.https://www.sciencedirect.com/journal/journal-of-systems-and-software

2.https://en.wikipedia.org/wiki/World_Wide_Web

CS624225 - **Software Project Management**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle (SDLC).
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.

UNIT 1: PROJECT EVALUATION AND PROJECT PLANNING	**9**
Importance of Software Project Management – Activities – Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	
UNIT 2: PROJECT LIFE CYCLE AND EFFORT ESTIMATION	**9**
Software process and Process Models – Choice of Process models – Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II – a Parametric Productivity Model.	
UNIT 3: ACTIVITY PLANNING AND RISK MANAGEMENT	**9**
Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning – Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.	
UNIT 4: PROJECT MANAGEMENT AND CONTROL	**9**
Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.	
UNIT 5: STAFFING IN SOFTWARE PROJECT	**9**
Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand Project Management principles while developing software.

CO2: Gain extensive knowledge about the basic project management concepts, framework and the process models.

CO3: Obtain adequate knowledge about software process models and software effort estimation techniques.

CO4: Estimate the risks involved in various project activities.

CO5: Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

REFERENCE BOOKS:

1.Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

2.Robert K. Wysocki ―Effective Software Project Management – Wiley Publication, 2011.

3.Walker Royce: ―Software Project Management- Addison-Wesley, 1998.

WEB RESOURCES:

1.https://www.g2.com/categories/resource-management

2.https://clickup.com/blog/resource-management-tools/

INSTITUTE ELECTIVE

CS624901: MODERN SENSOR TECHNOLOGY

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the fundamentals of sensor technology and its significance in industrial applications.
- To provide in depth knowledge in different types of Sensors.
- To implement the sensors for monitoring of Industrial Equipment.
- To provide knowledge in measuring various physical variables during industrial and scientific activities.
- To impart understanding of intelligent sensors, micro-sensors and Nano-sensors

UNIT 1: CHARACTERISTICS OF SENSORS **9**

Introduction to Instrument and their representation – Static performance characteristics of instruments – Dynamic characteristics of instruments – Transducer elements – Intermediate elements – Indicating, Recording and display elements

UNIT-2 : MEASUREMENT OF MECHANICAL COMPONENTS **9**

Motion and vibration measurements – Relative, absolute type vibration measurement devices - Dimensional metrology – Mechanical, Electromechanical, Pneumatic, Hydraulic dimensional gauging devices - Force measurement - Balance principle of force measurement – Hydraulic load cell – Pneumatic load cell – Elastic force devices – Electromechanical methods – Torque and power measurements – Transmission, Torsion, Driving, Absorption type dynamometer

UNIT-3 : SENSORS FOR EQUIPMENT MONITORING **9**

Pressure measurement – Moderate pressure measurement – High pressure Bridgeman Gauge – Low pressure measurement – Calibration of pressure gauges – Temperature measurement – Measurement of temperature – Non electrical methods of Temperature Measurement – Electrical Methods of Temperature measurement – Radiation Methods – Flow measurement – Acoustics measurement.

UNIT-4 : SENSORS FOR CONDITION MONITORING **9**

Vibration and Noise monitoring – Temperature monitoring – Wear behavior monitoring – Corrosion monitoring – Material defect monitoring - Acoustic emission monitoring technique – Performance trend monitoring – Selection of condition monitoring techniques – Expert system technique in fault diagnostics.

UNIT-5 : ADVANCEMENT IN SENSING TECHNOLOGY **9**

Specific gravity measurements – Measurements of liquid level – Viscosity – Humidity and Moisture – pH value – Biomedical measurements – Environmental air pollution measurement devices - Smoke density measurement – Fibre optic Transducers – Microsensors – Smart Sensors – Virtual Instrumentation

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Get the knowledge of various elements in sensor measurement.

CO2: Learn about the various sensors for motion, vibration, force and power

CO3: Familiarize with pressure, temperature and flow measurements

CO4: Find innovative solutions in monitoring physical parameters during on-line and off-line conditions.

CO5: Analyse the fundamental principles of advancement in sensor technology.

CO-PO MAPPING

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	2		2	-	-	-	-	2	-	2	2	-
CO2	2	2	2		2	-	-	-	-	2	-	2	2	-
CO3	2	2			2	-	-	-	-	2	-	2	-	2
CO4	2	2			2	-	-	-	-	2	-	2	-	2
CO5	2	2	2		2	-	-	-	-	2		2	-	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Nakra B.C. and Chaudhry K.K., "Instrumentation, Measurement and Analysis", Tata Mc Graw Hill, 4th Edition, 2017.

2.Wang L. and Gao R.X., "Condition Monitoring and Control for Intelligent Manufacturing", Springer - Verlog London Limited, 2006.

Reference Books

1.John Vetelino, AravindReghu, "Introduction to Sensors", CRC Press, 2017

2.Sinclair I.R., "Sensors and Transducers", Elsevier India Private Limited, 2001.

WEB RESOURCES:

1.https://www.techbriefs.com/component/content/article/tb/pub/features/articles/33212

2.https://www.hindawi.com/journals/js/2021/1527467/

CS624902: DECISION SUPPORT AND INTELLIGENT SYSTEMS						
Course Category: Institute Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	

COURSE OBJECTIVES:

- To review and clarify the fundamental terms, concepts associated with Decision Support Systems.
- To discuss the modelling and analysis of the Decision Support Systems.
- To understand the enterprise DSS and knowledge management.
- To understand the intelligent systems used in DSS.
- To discuss organizational and social implications of Decision Support Systems

UNIT 1:DECISION MAKING AND COMPUTERIZED SUPPORT	**9**

Decision Making: Introduction and Definitions - Managers and Decision Making - Managerial decision making and Information Systems - Managers and computerized support Need - framework for decision support – concept of decision support systems (DSS) –executive support systems - preview of the modeling process-phases of decision making process.

UNIT 2 : MODELING AND ANALYSIS	**9**

DSS components- DSS classifications - Data warehousing, access, analysis, mining and visualization - modeling and analysis- Static and dynamic models – influence diagrams – Optimization via mathematical programming – Heuristic programming – simulation – multidimensional modeling – model base management.

UNIT 3 : ENTERPRISE DECISION SUPPORT SYSTEMS	**9**

Group decision making – Group support systems- Technologies – Creativity and Idea generation - enterprise information systems (EIS) – Comparing and Integrating EIS and DSS - supply and value chain and DSS- supply chain problems and solutions – Computerized systems - knowledge management methods, technologies and tools.

UNIT 4 : INTELLIGENT SYSTEMS	**9**

Artificial intelligence (AI) – Concepts and Definitions – AI versus natural intelligence - expert systems-concepts, structure, types and benefits and problems – knowledge Engineering - knowledge acquisition and validation - knowledge representation – Techniques – Inference techniques.

UNIT 5 : IMPLEMENTATION, INTEGRATION, AND IMPACTS	**9**

Implementation – Major issues of implementation – implementation strategies – Models of integration – Intelligent DSS – Intelligent modelling and model management – problems and issues in integration - impact of management support systems - overview – personnel management issues – impact of Individuals – Impacts on productivity, quality and competitiveness – Issues of legality, privacy and ethics – Other societal impacts.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Demonstrate an understanding of the theory of decisions and decision analysis

CO2: Demonstrate the different models used in the DSS

CO3: Design an information system using emerging tools and technologies for a given business problem.

CO4: Describe the role of expert systems.

CO5: Illustrate the implementation, integration and impacts of Decision Support Systems

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Efraim Turban and Jay E Aronson, "Decision Support and Intelligent Systems", Prentice Hall, 9thEdition, 2010.

2.Elain Rich, Kevin Knight and Shivashankar B. Nair , "Artificial intelligence", Tata McGraw-Hill Publishing Company Limited, 3rd Edition, 2009.

Reference Books:

1.Daniel J. Power, "Decision Support Systems: Concepts and Resources for Managers", Greenwood Publishing Group, 1st Edition, 2002.

2.Quazi Khabeer, "Business Process Management and Decision Support Systems", Alpha Science International Limited, 1stEdition, 2013.

WEB RESOURCES:

1.https://www.researchgate.net/publication/277703502_Intelligent_Decision_Support_Systems

2.https://www.intechopen.com/chapters/10951