MASTER OF ENGINEERING IN COMPUTER SCIENCE AND ENGINEERING

(Academic Year **2019-20** onwards)

REGULATIONS

Eligibility:

B.E. or any other equivalent Engineering degree in Computer Science & Engineering / Information Technology / Electronics & Communication Engineering / Electrical & Electronics Engineering / Electronics & Instrumentation Engineering / Instrumentation & control Engineering with 50% of marks (SC/ST – 45%) or First Class in MCA /M.Sc. (CS) (SC/ST -45%).

Admission Procedure:

Applicants seeking admission to M.E. (Computer Science & Engineering) are required to appear for the Tamilnadu Common Entrance Test (TANCET) conducted by Anna University, Chennai, for the respective year or with a valid GATE score. Previous year TANCET score will not be considered for Admission.

Selection:

1. Selection for the M.E, programme will be made based on the valid GATE score / TANCET marks obtained for the respective year. Eligible GATE candidates will be given first priority.
2. All the qualified GATE candidates are eligible for AICTE PG Scholarship.
3. Admissions will be made based on Tamilnadu Government reservation policy.

Student Evaluation

1. Choice Based Credit System is followed for all the Courses.
2. Evaluation is based on continuous internal assessment (25%) and end-semester examination (75%). The Candidates have to score a minimum of 50% in the end semester examinations and 50% of total (Internal+External) in each Theory paper. For Practical papers, the maximum internal mark is 50 and the maximum external mark is 50. The condition to pass a practical paper is at par with theory paper.
3. A Minimum of 75% attendance is required to appear for the University Examinations.(University rules will be followed in case of candidates with less than prescribed % of attendance).
4. When a student completes the required 90 credits prescribed for the course, Overall Percentage of Marks (CGPA) will be calculated as follows. The marks obtained by the candidate (sum of external and internal marks) in a paper is multiplied by the credits assigned to the paper. Such weighted marks for all the papers are added and divided by the total credits
5. A paper should be presented in a national/international conference or published/accepted in a journal before the Viva-voce Examination of the Major project related to the Mini/Major Project.

MASTER OF ENGINEERING IN COMPUTER SCIENCE AND ENGINEERING

(Academic Year **2019-20** onwards)

PROGRAM EDUCATIONAL OBJECTIVES

Graduates of the Master of Engineering in Computer Science and Engineering program

I. shall apply basic principles and practices of computing grounded in mathematics and engineering to successfully complete hardware and/or software related engineering projects to meet customer business objectives and/or productively engage in research
II. Shall acquire knowledge to prepare articles for research publications
III. shall gain knowledge to get funded and collaborative projects and patents through the experience gained through mini and major projects
IV. shall possess a sense of professionalism and practice as computing professionals by the continuous internal assessment schemes and end- semester examination
V. Shall successfully function in multi-disciplinary teams
VI. shall be prepared for successful and productive engineering careers, possess technical competency, and be effective team members and effective communicators.
VII. shall adapt to new computing technologies through self-directed professional development andto innovate in providing technical solutions to engineering problems.

PROGRAM OUTCOMES

To achieve the overall Program Educational Objectives, our Computer Science and Engineering curriculum educates students who, at the time of their graduation,

a. will have the basic knowledge in the area of probability and statistics, and the ability to apply them to applications appropriate to computer engineering
b. will demonstrate the ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
c. will demonstrate an ability to handle simulation tools (wireless/wired/ Mobile, Ad-hoc/Cluster) and Data security (Data hiding, water marking, Digital signatures) and the ability toperform analysis and results of these simulations.
d. will demonstrate an ability to use the mathematical and computing techniques to develop application systems including medical image processing(defect detection), Pattern recognition (Finger print, face, characters), Satellite image processing etc., as per application requirements.
e. will work productively as Computer Engineers, including supportive and leadership roles on multidisciplinary teams
f. will demonstrate the basic employable skills in programming languages and to use software engineering principles, modern engineering tools, software and equipment to analyze problems.
g. will communicate effectively, recognize and incorporate societal needs and constraints in their professional endeavors

h. will Understand the theory and application of the scientific principles which underlie the physical characteristics of modern computers
i. will practice their profession with high regard to legal and ethical responsibilities,
j. will develop confidence for self-education and ability for life-long learning such as research to remain current in their profession and be leaders in our technological society.
k. will be able to participate and successfully attempt competitive examinations like SLET/NET,JRF etc.
l. educate poor and under privileged students from rural background to obtain better employment opportunity

Note Regarding Requirement of Credits

Students shall earn not less than 90 credits put together credits earned in all semester to declare themselves as qualified for the PG Programs. However as far as elective courses are concerned, students may opt the elective paper in such a manner that the overall credit earned shall not be less than the minimum requirement of 90 credits.

Programme Name : **M.E (CSE)**
SEMESTER : **I**

S.No	COURSE CODE	COURSE NAME	C	L	T	P	INT	EXT
1.		Mathematical Foundations of Computer Science	4	3	1	0	25	75
2.		Advanced Data structures & Algorithms	4	3	1	0	25	75
3.		Advanced Computer Architecture	4	3	1	0	25	75
4.		Advanced Computer Networks	4	3	1	0	25	75
5.		Advanced Software Engineering	4	3	1	0	25	75
6.		Machine learning Techniques	4	4	0	0	25	75
7.		Network Programming Lab	2	0	0	4	50	50
8.		Data structures Lab	2	0	0	4	50	50
TOTAL CREDITS 28								

C-Credits L-Lecture T-Tutorial P-Practices

***Refer Annexure-A: List of Elective Course**

PROGRAMME NAME : **M.E (CSE)**
SEMESTER : **II**

S.No	COURSE CODE	COURSE NAME	C	L	T	P	INT	EXT
1.		Advanced Network Security Practices	4	3	1	0	25	75
2.		Big Data Analytics	4	3	1	0	25	75
3.		Internet of Things	4	3	1	0	25	75
4.		Advanced Operating Systems	4	3	1	0	25	75
5.		Elective I *	3	3	0	0	25	75
6.		Elective II *	3	3	0	0	25	75
7.		Research and Documenting practices	2	0	0	4	50	50
8.		Data Analytics Lab	2	0	0	4	50	50
TOTAL CREDITS 26								

COURSE NAME : **M.E (CSE)**
SEMESTER : **III**

S.No	COURSE CODE	COURSE NAME	C	L	T	P	INT	EXT
1.		Elective III *	3	3	0	0	25	75
2.		Elective IV *	3	3	0	0	25	75
3.		Elective V *	3	3	0	0	25	75
4.		Mini Project	9	0	0	15	50	50
TOTAL CREDITS 18								

*** Refer Annexure-A (List of Elective Courses)**

COURSE NAME : **M.E (CSE)**
SEMESTER : **IV**

S.No	COURSE CODE	COURSE NAME	C	L	T	P	INT	EXT
1		Major Project	18	0	0	30	50	50
TOTAL CREDITS18								

CREDIT SUMMARY	
SEMESTER I	**28**
SEMESTER II	**26**
SEMESTER III	**18**
SEMESTER IV	**18**
TOTAL CREDITS	**90**

*** Refer Annexure-A (List of Elective Courses)**

Annexure-A

List of ELECTIVES

1. DIGITAL IMAGE PROCESSING
2. SOFT COMPUTING
3. DATA MINING & DATA WAREHOUSE
4. AD HOC & SENSOR NETWORKS
5. NETWORK SECURITY
6. CLOUD COMPUTING
7. BIO INFORMATICS
8. EVOLUTIONARY ALGORITHMS
9. PARALLEL COMPUTING
10. NATURAL LANGUAGE PROCESSING
11. ROBOTICS
12. COMPUTER VISION
13. REAL TIME SYSTEMS
14. CYBER FORENSICS
15. INFORMATION STORAGE
16. INFORMATION RETRIEVAL
17. COMPUTATIONAL BIOLOGY
18. HETEROGENOUS WIRELESS NETWORK
19. LED LIGHT COMMUNICATIONS: TOWARDS NETWORKED LI-FI
20. REMOTE SENSING AND GIS
21. DEEP LEARNING

C	L	T	P
4	4	0	0

MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

COURSE OBJECTIVES:

- To provide the strong fundamentals on sets, phrase structure grammar, automata and formal languages, etc., that will help the students in writing programs.
- To improve the logical reasoning while programming with computer languages.

Unit I **12**

Algebraic structures: Algebraic systems – Properties – Semi groups - Monoids – Homeomorphisms – Substructures of semigroups and monoids – Groups – Subgroups – Homeomorphisms – Cossets – Lagrange's theorem – Normal subgroups- Fundamental Homomorphism theorem.

Unit II **12**

Logic – Statement – Proposition and its types – Negation, Disjunction, Conjunction and connectives – Truth table construction - Tautology and contradictions – bi-conditional propositions- Logical equivalence – Logical implications – Principle disjunctive and conjunctive normal forms- Theory of inference – Predicate calculus.

Unit III **12**

Set theory and relations: Basic operations on sets – Power set – Properties of set operations – Properties of subsets – Basic set identities – Functions – Inverse functions- composition of functions – Relations on sets – Properties of relations – Equivalence relations.

Unit IV **12**

Automata and Formal Languages: Finite Automata – Representation of finite automata – Deterministic and non-deterministic automata –Languages accepted by finite automata- Equivalence of FA and NFA.

Unit V **12**

Phrase structure grammars: Chomsky Hierarchy of languages – Finite automata and regular languages – Derivation tress for context-free languages – Normal forms for context-free grammars.

COURSE OUTCOMES:

- Acquire the basic knowledge of set theory, logic, phrase structure grammer, etc., which are necessary for designing and solving problems
- Acquire the knowledge of logical operations and predicate calculus needed for computing skill
- Able to design and solve Boolean functions for defined problems
- Apply the acquired knowledge of formal languages to the engineering areas like Compiler Design

Reference Books:

1. J.P. Trembley and R. Manokar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill Publications.

2. M.K. Venkataraman, N. Sridharan and N. Chandrasekaran, Discrete Mathematics, The National Publishing Company, Chennai (2003).

C	L	T	P
4	4	0	0

ADVANCED DATA STRUCTURES & ALGORITHMS

OBJECTIVES:

- To extend the students' knowledge of algorithms and data structures, and to enhance their expertise in algorithmic analysis and algorithm design techniques.
- Expected to learn a variety of useful algorithms and techniques and extrapolate from them in order to then apply those algorithms and techniques to solve problems

UNIT I : FUNDAMENTALS 12

Algorithm efficiency –Space Complexity-Time Complexity-Asymptotic Notations-. Linked Lists : Singly Linked List –Doubly Linked List – Circular Linked List - Application-Polynomial Manipulation.

UNIT II :LINEAR DATA STRUCTURES 12

Stack : Structure-Array and Linked List-Operations-Applications of stacks-Reverse a List-Evaluation of Arithmetic Expression. Queues: Structure- Array and Linked List- Operations-Application-Round Robin Algorithm Circular Queue.

UNIT III: TREES 12

Trees: Tree, Binary tree and its types – Expression Tree - Binary tree traversal- Search trees: Binary search trees- AVL Trees- Red black trees- Multi way search trees- k-d Trees-Min/Max heaps.

UNIT IV: GRAPHS 12

Graph and its types - Structures- Operations- Applications- Shortest Path Problem-Minimum Cost Spanning Trees-Kruskal‘s Algorithm- Prim’s Algorithm,Connected components – Sorting – Merge sort – Quick sort – Insertion sort.

UNIT V : ALGORITHMS 12

Introduction to Algorithm-Design Methods: The greedy Method –Knapsack Problem-Divide and conquer Method-Quick sort-Dynamics Programming- Travelling salesperson-Backtracking-The 8-Queens Problem.

OUTCOMES:

- Basic ability to analyze algorithms and to determine algorithm correctness and time efficiencyclass.
- Master a variety of advanced data structures and their implementations.
- Master different algorithm design techniques in computational geometry and in parallel algorithms.

- Ability to apply and implement learned algorithm design techniques and data structures to solveproblems.
- **TEXT AND REFERENCES:**

- Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms, Pearson Education, New Delhi, 2006.
- Sahni, Data Structures, Algorithms and Applications in C++, McGraw Hill.
- Data Structures, A Pseudo code Approach with C++-Gilberg, Ferouzan-Brooks/Cole-CENGAGE Learning, 2008.
- Computer Algorithm/C++ -Ellis Horowitz SartajSahni, S. Rajasekaran –University press, 2008.
- Objected Oriented Data Structures using C++ -K.S.Easwarakumar5. Vikas Publishing House(P) Ltd.
- Data Structures and Algorithm, Concepts, Techniques and Application- G.A.V. Pai- The McGraw-Hill companies-2008.
- Classic Data Structures- D .Samantha-Prentice Hall of India Pvt LTd, 2002.

C	L	T	P
3	4	0	0

ADVANCED COMPUTER ARCHITECTURE

OBJECTIVES:

To make the students to:

- Understand the need for advanced computer architecture
- Describe the several architectures and software's used for parallel computing
- Apply the concepts to solve the real world problems

Unit I – Theory of Parallelism **12**

Elements of Modern Computers –Evolution of Computer Architecture – System Attributes to Performance - Multiprocessor and Multicomputers – Multivector and SIMD Computers –PRAM and VLSI Models –Architectural Development Tracks –Conditions of parallelism – Program Partitioning and Scheduling – System Interconnect Architectures.

Unit II – Hardware Technologies **12**

Advanced Processor Technology – Superscalar and Vector Processors – Memory Hierarchy Technology – Virtual Memory Technology- Cache memory organizations- Shared Memory Organizations - Instruction Pipeline Design- Arithmetic Pipeline Design.

Unit III – Parallel Architectures **12**

Multiprocessor system Interconnects – Cache Coherence and Synchronization Mechanisms – Message Passing Mechanisms – SIMD computer organizations – Connection Machine-5 Network Architecture – Principles of Multithreading – Fine Grain Multicomputers.

Unit IV – Software for Parallel Programming **12**

Parallel Programming Models – Parallel Languages and Compilers – Code Optimization and scheduling – Loop Parallelization and Pipelining -Parallel Programming Environments – Synchronization and Multiprocessing Modes – Shared Variable Program Structures - Message Passing Program Development – Mapping Programs onto Multicomputers.

Unit V - Instruction and System Level Parallelism **12**

Instruction Level Parallelism –Trends in Parallel Systems: Overview of Technology – Forms of Parallelism – Parallel Programming Models and Languages.

Outcomes:

At the end of the course the student will be:

- Able to describe the advanced hardware technology
- Able to understand the needs for the parallel architecture
- Apply the software for the parallel programming

Text Book:

- KAI HWANG & NARESH JOTWANI “Advanced Computer Architecture Parallelism, Scalability, Programmability”, McGraw Hill, Second Edition,2011

Reference Books:

1. Torence Fountain, Peter Kacsuk, De Zso Sigma, “Advanced Computer Architectures (A design Space approach) “, Pearson Education Asia
2. William Stallings, “Computer Organization and Architecture “Macmillan Publishing Company

C	L	T	P
4	4	0	0

ADVANCED COMPUTER NETWORKS

OBJECTIVES:

- To enable the students to learn about the advanced computer networks especially the architecture, protocols and other related concepts.

Unit –I **12**

Topology of Computer Network- Architecture of a Computer Network- Network Architecture Models- Partitioning of a system- Layered architecture of a Computer Network – Need for standardization of Network Architecture – Open System interconnection – Layered Architecture of the OSI Reference model – Functionality of the Layered architecture- Hierarchical Communication-Peer to Peer Communication- Service Interface- Data Transfer modes.

Unit –II **12**

LAN Bridge-Transparent Bridges-Spanning Tree Algorithm- Source Routing Bridges-Route Discovery in Source Routing-Network Layer-Wide area Networks-Circuit Switching- Store and Forward Data Networks-Types of Packet switched Data Networks- Purpose of the Network Layer-Network Service.

Unit–III **12**

X.25 Interface-X.25 Services-General Packet Format-Procedures for Switched Virtual Circuits- Addressing in X.25-Packet assembler and Disassembler-PAD operation-Frame Relay-Frame Relay Network Topology-Frame Relay Connection-Frame Relay Services- Frame format in Frame Relay-Basic operation of LAP-F-IP Encapsulation-Asynchronous Transfer Mode-UNI and NNI-ATM Virtual Channel connection- Virtual Path Connection-Layered Architecture in ATM-Physical Layer-ATM Layer-ATM Adaption Layer.

Unit-IV **12**

Internet Protocol- Internet Protocol (IP)-Hierarchical Addressing-Subnetting-Address Resolution Protocol-Internet Control Message Protocol (ICMP)-IPV6 Internet Protocol-Point to Point Protocol-Link Control Protocol-Quality of Service –Routing-Static Routing-Dynamic Routing-Distance Vector Routing Algorithm- Routing Information Protocol (RIP)-Link state Routing-Open Shortest Path First (OSPF) Routing Protocol.

Unit-V **12**

Transport Layer-Transmission Control Protocol (TCP)-TCP Ports and Connections-Format of TCP segment-TCP operation-Flow Control in TCP-Congestion Avoidance in TCP-Application Layer –TCP/IP Application Protocols-Domain Name System-Bootstrapping Protocol(BOOTP)-Dynamic Host Configuration Protocol (DHCP)-Trivial File Transfer Protocol(TFTP)- File Transfer Protocol(FTP)-Electronic Mail-Simple Network Management Protocol(SNMP).

OUTCOMES:

At the end of the course the students will:

- Be able to describe about the advanced computer network architechture and the several protocols used in it.
- Be able to apply it in the practical networking.

Text Book:

1. Data Communications and Computer Networks-Prakash C.Gupta, PHI Learning Private Limited 2006

Reference:

1. Computer Network-Tanenbaum-PHI Learning Edition 2012
2. Data Communication and Networking –Forouzan, Tata McGraw Hill Edition 2011
3. Data Communication and Networks-Trivedi,Oxfor University Press,2016.

C	L	T	P
4	4	0	0

ADVANCED SOFTWARE ENGINEERING

OBJECTIVES:

To understand Software Engineering Lifecycle Models, project management and cost estimation,gain knowledge of the System Analysis and Design concepts,understanding software testing approaches and to be familiar with DevOps practices

UNITI-INTRODUCTION 12

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNITII SOFTWARE REQUIREMENT SPECIFICATION 12

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT III ARCHITECTURE AND DESIGN 12

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter.-User interface design.

UNIT IV TESTING 12

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS 12

DevOps:Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture - Building and Testing-Deployment- Case study: Migrating to Microservices.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course, the students will be able to:
- Understand the advantages of various Software Development Lifecycle Models
- Gain knowledge on project management approaches as well as cost and schedule estimation strategies

- Perform formal analysis on specifications
- Use UML diagrams for analysis and design
- Architect and design using architectural styles and design patterns
- Understand software testing approaches
- Understand the advantages of DevOps practices

REFERENCES:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2 nd edition, Pearso Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2 nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, —DevOps: A Software Architect‘s Perspectivell, Pearson Education, 2016
5. Rajib Mall, Fundamentals of Software Engineering, 3 rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

MACHINE LEARNING TECHNIQUES

OBJECTIVES:

- To prepare the students to understand and learn the machine learning techniques and to apply the techniques for solving real time problems.

UNIT I **9**

FOUNDATIONS OF LEARNING Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization tradeoff – bias and variance – learning curve 3

UNIT II **9**

LINEAR MODELS Linear classification – univariate linear regression – multivariate linear regression – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures – support vector machines – soft margin SVM – going beyond linearity – generalization and overfitting – regularization – validation

UNIT III **9**

DISTANCE-BASED MODELS Nearest neighbor models – K-means – clustering around medoids – silhouttes – hierarchical clustering – k-d trees – locality sensitive hashing – non-parametric regression – ensemble learning – bagging and random forests – boosting – meta learning

UNIT IV **9**

TREE AND RULE MODELS Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first-order rule learning

UNIT V **9**

REINFORCEMENT LEARNING Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an actionutility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control

OUTCOMES:

At the end of the course the students will be able to:

- Describe the various machine learning concepts and models.
- Apply the concepts for the practical problems.

- Compare and analyse the performance of various machine learning algorithms.

REFERENCES:

1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.
2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.
3. K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
4. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
5. D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2012.
6. M. Mohri, A. Rostamizadeh, and A. Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
7. T. M. Mitchell, “Machine Learning”, McGraw Hill, 1997.
8. S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition, Prentice Hall, 2009
9. Peter Flach,”Machine Learning”,Cambridge University Press,2015.
10. ShaiShalar–Scwartz&Shai Ben-David,”Understand Machine Learning,Cambridge University Press,2015.

NETWORK PROGRAMMING LAB

OBJECTIVE:

- To acquire the knowledge about different Network protocols.
- To perform simulations with various network parameter to compare the performance of network protocols.
- To Learn and design various network environments.
- To Learn secured communication.

List of Experiments

CYCLE-I

The Following Experiments are Emulated with LAN-Trainer Kit

1.CSMA,CSMA/CD ,CSMA/CA

2.BUS and Ring Topology(Token)

3.Stop and Wait

4.Sliding Window

5.Packet transmission Analysis

6.FTP

7.Implementation of Security in data Transmission.

CYCLE-II

The Following Experiments are simulated with NETSIM Simulator

1. Simulation of Network Environment
2. Simulation of Wired Network and its performance measure
3. Simulation of Wireless Network and its performance measure
4. Simulation of Inter Network and its performance measure
5. Simulation of Mobile Network and its performance measure
6. Simulation of IOT Network and its performance measure

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Design and implement different Network protocols
- Design simulations with various network parameter to compare the performance of network protocols
- Design and Learn network environments.

DATA STRUCTURES LABORATORY

OBJECTIVES:

- To acquire the knowledge of using advanced treestructures.
- To learn the usage of heapstructures.
- To understand the usage of graph structures and spanningtrees.

LIST OF EXPERIMENTS:

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required forconcurrency. Exercises should be designed to cover the following topics:

EXPERIMENTS:

1. Implementation of Merge Sort and QuickSort-Analysis
2. Implementation of a Binary SearchTree
3. Red-Black TreeImplementation
4. HeapImplementation
5. Fibonacci HeapImplementation
6. GraphTraversals
7. Spanning TreeImplementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann FordAlgorithm)
9. Implementation of Matrix ChainMultiplication
10. Activity Selection and Huffman CodingImplementation.

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Design and implement basic and advanced data structuresextensively.
- Design algorithms using graphstructures
- Design and develop efficient algorithms with minimum complexity using designtechniques.

ADVANCED NETWORKSECURITY PRACTICES

OBJECTIVES:

- To learn the core fundamentals of system and web securityconcepts
- To have through understanding in the security concepts related tonetworks
- To deploy the security essentials in ITSector
- To be exposed to the concepts of Cyber Security and encryptionConcepts
- To perform a detailed study of Privacy and Storage security and relatedIssues.

UNIT I SYSTEM SECURITY 9

Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers.

UNIT II NETWORK SECURITY 9

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

UNIT III SECURITY MANEGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System.

UNIT IV CYBER SECURITY AND CRYPTOGRAPHY 9

Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - NetworkForensics-DataEncryption-SatelliteEncryption-Passwordbasedauthenticated Key establishment Protocols.

UNIT V PRIVACY AND STORAGE SECURITY 9

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

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course the students should be able to

- Understand the core fundamentals of systemsecurity
- Apply the security concepts related to networks in wired and wirelessscenario
- Implement and Manage the security essentials in ITSector
- Able to explain the concepts of Cyber Security and encryptionConcepts
- Able to attain a through knowledge in the area of Privacy and Storage security and relatedIssues.

REFERENCES:

1. John R.Vacca, Computer and Information Security Handbook, Second Edition, Elsevier 2013.
2. Michael E. Whitman, Herbert J. Mattord, Principal of Information Security, Fourth Edition, Cengage Learning, 2012.
3. Richard E.Smith, Elementary Information Security, Second Edition, Jones and Bartlett Learning, 2016

BIG DATA ANALYTICS

OBJECTIVES:

- To understand the competitive advantages of big dataanalytics
- To understand the big dataframeworks
- To learn data analysismethods
- To learn streamcomputing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big dataanalytics

UNITI INTRODUCTION TO BIGDATA 7

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

UNITII HADOOP FRAMEWORK 9

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

UNITIII DATA ANALYSIS 13

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

UNIT IV MININGDATASTREAMS 7

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

UNITV BIGDATAFRAMEWORKS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand how to leverage the insights from big dataanalytics
- Analyze data by utilizing various statistical and data miningapproaches
- Perform analytics on real-time streamingdata
- Understand the various NoSql alternative databasemodels

REFERENCES:

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

INTERNET OF THINGS

OBJECTIVES:

- To understand the fundamentals of Internet ofThings
- To learn about the basics of IOTprotocols
- To build a small low cost embedded system using RaspberryPi.
- To apply the concept of Internet of Things in the real worldscenario.

UNITI INTRODUCTION TOIoT 9

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

UNITII IoT ARCHITECTURE 9

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

UNITIII IoTPROTOCOLS 9

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

UNITIV BUILDING IoT WITH RASPBERRY PI&ARDUINO 9

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

UNITV CASE STUDIES ANDREAL-WORLDAPPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid,Commercialbuildingautomation,Smartcities-participatorysensing-DataAnalyticsforIoTSoftware&ManagementToolsforIoTCloudStorageModels&CommunicationAPIs-Cloudfor IoT - Amazon Web Services for IoT.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Analyze various protocols forIoT
- Develop web services to access/control IoTdevices.
- Design a portable IoT using RasperryPi
- Deploy an IoT application and connect to thecloud.
- Analyze applications of IoT in real timescenario

REFERENCES:

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

ADVANCED OPERATING SYSTEMS

OBJECTIVES:

- To enable the students to learn about the advanced functionalities of the modern operating systems and to make them to apply the concepts in the real time problem.

UNIT I FUNDAMENTALS OF OPERATING SYSTEMS 12

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

UNIT II DISTRIBUTED OPERATING SYSTEMS 12

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

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 12

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

UNIT IV REAL TIME AND MOBILE OPERATING SYSTEMS 12

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

UNIT V CASE STUDIES 12

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

OUTCOMES:

At the end of the course the students will be able to :

- Describe about the advanced operating systems
- Understand the necessity of the modern advanced OS.
- Apply the concepts in selecting the Advanced OS.

REFERENCES:

1. MukeshSinghal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001.

2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, “Operating System Concepts”, Seventh Edition, John Wiley & Sons, 2004.

3. Daniel P Bovet and Marco Cesati, “Understanding the Linux kernel”, 3rd edition, O’Reilly, 2005.

4. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2006.

5. Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, Fourth Edition, Payload media,

Research and Documenting practices

In this course, students are trained to sharpen their technical reading and writing skills that they need to understand and draft technical / research articles. A Research paper requires a student to obtain information from a variety of sources such as Journals, periodicals, reference books,web resourcesand on the basics of this information they can propose new ideas.

The Methodology adopted is as Following.

Selecting an area of interest, making an objective, writing a literature review, preparing a work plan,critical analysis of existing works, identifying issues / limitations,shortfalls, proposing a new problem, methodology, drafting and complying a new article.

Periodic activity

1. Selection of Areas finding an objective -1 week
2. Collection of Background text information

   about the (Books, websites, e-learning materials) -2 weeks
3. Selecting the journals and Conference proceedings

   in the problem domain -1 week
4. Preparing and presenting the survey report

   (interms of Author,paper,contributions specific methodology and -2weeksIssues/Limitations)
5. Preparing a draft proposed with problem statement/Hypothesis detailed

   Flow diagram and goals and proposed contributions -2 weeks
6. Drafting of paper with diagram,citations,graphs,tables,equations
7. using tools such as Latex/Msword in standard IEEE Format -1 week
8. Writing Conclusion and Future development,final paper drafting

   Presenting the proposal using presentation software -1 week

Internal	
Review-I	Area, Topic, Background study Progress of the Problem domain (5 marks)
Review-II	Literature survey,Survey Report with Author/Journal/Contributions /issues, problem statement, methodology prepared.(10 marks)
Review-III	Design details, Proposed Contributions,paper drafting, ReportFormatting using LATEX(10 marks)
External	
Final viva	Overall PPT presentations of the entire work()

DATA ANALYTICS LABORATORY

OBJECTIVES:

- To implement Map Reduce programs for processing bigdata
- To realize storage of big data using H base, MongoDB
- To analyse big data using linear models
- To analyse big data using machine learning techniques such as SVM / Decision tree classification andclustering

LIST OF EXPERIMENTS

Hadoop

1. Install, configure and run Hadoop andHDFS
2. Implement word count / frequency programs usingMapReduce
3. Implement an MR program that processes a weatherdataset

R-Tool

4. Implement Linear and logisticRegression
5. Implement SVM / Decision tree classificationtechniques
6. Implement clusteringtechniques
7. Visualize data using any plottingframework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop /R.

TOTAL: 60 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Process big data using Hadoopframework
- Build and apply linear and logistic regressionmodels
- Perform data analysis with machine learningmethods
- Perform graphical dataanalysis

LIST OF SOFTWARE FOR A BATCH OF 30 STUDENTS:

- Hadopp
- YARN
- R package
- Hbase
- MongoDB

REFERENCES:

1. Alan Gates and Daniel Dai, "Programming Pig – Dataflow scripting with Hadoop", O'Reilley, 2nd Edition, 2016.
2. Gareth James,DanielaWitten,TrevorHastieandRobertTibshirani,-An Introduction to Statistical Learning with Applications in R, Springer Publications, 2015(Corrected 6th Printing)

3. Hadley Wickham,‖ggplot2 – Elegant Graphics for Data Analysis‖, Springer Publications,2nd Edition, 2016
4. Kristina Chodorow, "MongoDB: The Definitive Guide – Powerful and Scalable Data
Storage", O'Reilley, 2nd Edition, 2013.
5. Lars George, "HBase: The Definitive Guide", O'Reilley, 2015.
6. Tom White, -Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale‖, O'Reilley, 4th Edition, 2015.

ELECTIVE PAPERS

DIGITAL IMAGE PROCESSING

OBJECTIVES:

- To understand the basic concepts of digital image processing and various image transforms.
- To familiarize the student with the image processing facilities in Mat lab.
- To expose the student to a broad range of image processing techniques and their applications, and
- to provide the student with practical experience using them.
- To appreciate the use of current technologies those are specific to image processing systems.
- To expose the students to real-world applications of image processing

Unit 1 **10**

Introduction: What is Digital Image Processing? – Fundamentals Steps in DIP – Components of an Image Processing System.

Digital Image Fundamentals: Light and Electromagnetic Spectrum – Image Sensing and Acquisition – Image Sampling and Quantization – Some Basic Relationships Between Pixels.

Unit 2 **10**

Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformations – Histogram Processing – Enhancement Using Arithmetic/Logic Operations – Basics of Spatial Filtering – Smoothing Spatial Filters – Sharpening Spatial Filters.

Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain – Smoothing Frequency-Domain Filters – Sharpening Frequency Domain Filters.

Unit 3 **10**

Image Restoration: A Model of the Image Degradation/Restoration Process – Noise Models – Restoration in the presence of Noise Only-Spatial Filtering – Periodic Noise Reduction by Frequency Domain Filtering.

Image Compression: Fundamentals – Image Compression Models – Error-free Compression – Lossy Compression – Image Compression Standards.

Unit 4 **8**

Morphological Image Processing: Preliminaries – Dilation and Erosion – Opening and Closing – The Hit-or-Miss Transformation – Some Basic Morphological Algorithms – Extensions to Gray-Scale Images.

Segmentation: Detection and Discontinuities – Edge Linking and Boundary Detection – Thresholding – Region-Based Segmentation.

Unit 5 **7**

Representation and Description: Representation – Boundary Descriptors – Regional Descriptors.

Object Recognition: Patterns and Pattern Classes – Recognition Based on Decision-Theoretic Methods – Structural Methods.

OUTCOMES:

Upon Completion of the course, the students

- Should have a clear impression of the breadth and practical scope of digital image processing and
- have arrived at a level of understanding that is the foundation for most of the work currently underway in this field.
- Implement basic image processing algorithms using MATLAB tools
- Explore advanced topics of Digital Image Processing.4
- Ability to Apply and develop new techniques in the areas of image enhancement-restoration - segmentation-compression-wavelet processing and image morphology.
- Make a positive professional contribution in the field of Digital Image Processing.

Text & Reference Books:

1. Digital Image Processing – Rafael C.Gonzalez and Richard E.Woods, Pearson Education, 2009.
2. Digital Image Processing and Analysis – B.Chanda and D.DuttaMajumder , Prentice Hall India – 2009.
3. Digital Image Processing – S.Jayaram, S.Esakkirajan, T.Veerakumar , Tata McGraw Hill Education Private Limited, New Delhi, 2009.
4. Digital Image Processing for medical Applications-Geoff Doucherty,Cambridge University Press,2015.

SOFT COMPUTING

OBJECTIVES:

The student should be made to:

- Learn the various soft computing frame works.
- Be familiar with design of various neural networks.
- Be exposed to fuzzy logic.
- Learn genetic programming.
- Be exposed to hybrid systems.

UNIT I - NEURAL NETWORK AND SUPERVISED LEARNING NETWORK 9

Basic Concepts of Neural networks – Evolution of Neural networks-Basic Models of Artificial neural network - Terminologies of ANN-McCulloch - Pitts Neuron - Linear seperability - Hebb Network - Applications of Neural networks.

Supervised learning Network – Introduction – Perceptron Networks – Adaptive Linear Neuron – Multiple Adaptive Linear Neurons – Back propagation Network – Radial Basis function Network.

UNIT II - ASSOCIATIVE MEMORY NETWORKS & UNSUPERVISED LEARNING NETWORKS 11

Associative Memory Networks - Introduction – Training algorithms for pattern association – Autoassociative Memory Network – Bidirectional Associative Memory – Hopfield Networks.

Unsupervised Learning networks - Introduction – Fixed Weight Competitive Nets - Kohonen Self - Organised Maps – Learning Vector Quantization – Adaptive Resonance Theory Network.

.UNIT III - FUZZY LOGIC 10

Introduction to Classical Sets and Fuzzy Sets—Introduction – Classical sets – Fuzzy Sets. Classical Relation and Fuzzy Relations-Introduction – Cartesian product of a relation -Classical Relation – Fuzzy Relations..Membership Functions – Introduction - Features of Membership Functions – Fuzzification – Methods of Membership Value Assignments.Defuzzification –Introduction – Lambada-Cuts for Fuzzy Sets-Lambada-Cuts for Fuzzy Relations –Defuzzification Methods.

UNIT IV - GENETIC ALGORITHM **7**

Fundamentals of Genetic Algorithms - History – Basic concepts – Creation of Offsprings – Working principle – Encoding – Fitness Function – Reproduction . Genetic Modelling – Inheritance Operators – Cross Over – Inversion and Deletion – Mutation Operator – Bit-wise Operators – Bit-wise Operators used in GA – Generational Cycle – Convergence of Genetic Algorithm –Differences and similarities between GA and Other Traditional Methods - Advances in Genetic Algorithm.

UNIT V - HYBRID SYSTEMS AND APPLICATIONS OF SOFT COMPUTING **8**

Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms – Hybrid Systems –Neural Networks, Fuzzy Logicand Genetic Algorithms Hybrids- Preview of the Hybrid systems to be discussed.Genetic Algorithm based Backpropogation Networks-GA based weight determination.ANFIS-Adaptive Neuro - Fuzzy Inference Systems – Introduction – ANFIS Architecture – Hybrid Learning Algorithm. Coactive Neuro - Fuzzy Modeling-Introduction – Framework.

Applications of Soft Computing - Introduction – A Fusion approach of Multispectral Images with SAR Image for Flood area Analysis - Optimization of TSP using Genetic Algorithm Approach – Genetic Algorithm based Internet Search Technique.

OUTCOMES:

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

- Apply various soft computing frame works.
- Design of various neural networks.
- Use fuzzy logic.
- Apply genetic programming.
- Discuss hybrid soft computing.

REFERENCES:

1. S.N Sivanandam S.N Deepa “Principles of Soft Computing”, Wiley –India, 2007.
2. S.Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2004.
3. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI,Pearson Education 2004.
4. S.N.Sivanandam, S.N.Deepa, “Introduction to Genetic Algorithms”, Springer, 2007.
5. Timothy J.Ross,”Fuzzy Logic with Engineering Application “, McGraw Hill, 2000.
6. Davis E.Goldberg,” Genetic Algorithms: Search, Optimization and Machine Learning” Addison Wesley, N.Y., 2003.

DATA MINING & DATA WAREHOUSE

OBJECTIVES:

- To Understand Data mining principles and techniques and Introduce DM as a cutting edge
- business intelligence
- To expose the students to the concepts of Datawarehousing Architecture and Implementation
- To study the overview of developing areas – Web mining, Text mining and ethical aspects of Datamining
- To identify Business applications and Trends of Data mining

UNIT I **9**

Data warehousing and Business Analysis: - Data warehousing components- Building a Data warehouse-Three-tier Data warehouse Architecture- DBMS Schemas for Decision Support – Data Extraction, Cleanup and Transformation Tools- Metadata- Reporting- Query tools and Applications- OnLine Analytical Processing(OLAP)- OnLine Transaction Processing(OLTP)- OLAP and Multidimensional Data Analysis.

UNIT II **9**

Data Mining:- Data Mining Functionalities- Data PreProcessing- Data Cleaning- Data Integration and Transformation- Data Reduction- Data Discretization and Concept Hierarchy Generation.

Association Rule Mining:- Efficient and Scalable Frequent Item Set Mining Methods- Basic Algorithms-Apriori Algorithm -Mining Various Kinds of Association Rules- Association Mining to Correlation Analysis.

UNIT III **9**

Classification and Prediction:- Issues Regarding Classification and Prediction- Classification by Decision Tree- Bayesian Classification- Rule Based Classification- Classification by Back Propagation- Support Vector Machines- Associative Classification- Lazy Learners- Other Classification Methods- Prediction- Accuracy and Error Measures- Evaluating the Accuracy of a Classifier or Predictor- Ensemble Methods- Model section.

UNIT IV **9**

Cluster Analysis:- Types of Data in Cluster Analysis- A Categorization of Major Clustering Methods:K-means clustering- Partitioning Methods- Hierarchical Methods- Density-Based Methods- Grid-Based Methods- Model-Based Clustering Methods – Clustering High- Dimensional Data- Constraint-Based Cluster Analysis- Outlier Analysis.

UNIT V **9**

Mining Object, Spatial, Multimedia, Text and Web Data:

Multidimensional Analysis and Descriptive Mining of Complex Data Objects- Spatial Data Mining-Generalization and Specialization –Temporal Mining: Introduction-Time series- Pattern detection- Temporal association rules- Mining the World Wide Web.

OUTCOMES:

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

- Describe the data warehousing and data mining activities
- Discover the knowledge imbibed in the high dimensional system
- Evaluate various mining techniques on complex data objects

REFERENCES:

1. Jiawei Han and MichelineKamber “Data Mining Concepts and Techniques” Second Edition, Elsevier, Reprinted 2008.
2. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw-Hill Edition, Tenth Reprint 2007.
3. K.P. Soman, ShyamDiwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
4. G.K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.

AD HOC & SENSOR NETWORKS

OBJECTIVES:

- To enable the students to learn and understand the fundamental concepts behing the ADHOC and Sensor Networks and its applications in the practical life.

Unit-I **8**

Introduction – Applications of MANET's – Challenges

Routing In Ad Hoc Networks: Introduction – Topology-Based versus Position-Based Approaches – Topology-Based Routing Protocols – Position-Based Routing – Other Routing Protocols

Unit-II **10**

Broadcasting, Multicasting and Geocasting: Introduction – The Broadcast Storm – Multicasting – Geocasting.

Wireless LANs: Transmission Techniques – Medium Access Control Protocol Issues – The IEEE 802.11 Standard for Wireless LANs – Enhancement to IEEE 802.11 MAC.

Unit-III **8**

Wireless PANs: Why Wireless PANs – The Bluetooth Technology – Enhancements to Bluetooth – Comparison between WPAN Systems – WLANs versus WPANs.

Directional Antenna Systems: Antenna Concepts – Evolution of Directional Antenna Systems – Advantages of using Directional Antennas – Directional Antennas for Ad Hoc Networks – Protocol Issues on the use of Directional Antennas – Broadcasting.

Unit-IV **10**

Wireless Sensor Networks: The Mica Mote – Sensing and Communication Range – Design Issues – Energy Consumption – Clustering of Sensors – Applications

Data Retrieval in Sensors Networks: Introduction – Classifications of WSNs – MAC Layer – Routing Layer – High-Level Application Layer Support – Adapting to the Inherent Dynamic Nature of WSNs.

Unit-V **9**

Security: Security in Ad Hoc Networks – Key Management – Secure Routing – Cooperation in MANFET's – Wireless Sensor Networks – Intrusion Detection Systems.

Integrating MANFET's WLANs and Cellular Networks: Ingredients of a Heterogeneous Architecture – Protocol Stack – Comparison of the Integrated Architectures.

OUTCOMES:

At the end of the course the students will be:

- Able to describe the features of Ad-hoc and Sensor networks
- Able to appreciate the need for underlying concepts of Adhoc and Sensor networks
- Able to design a new network based on their needs

References:

1. Ad hoc & sensor networks – Carlos de MoraisCordeiro - World Scientific – 2010
2. Wireless Ad hoc & Sensor networks – Xiang-Yang Li – Cambridge University Press – 2008
3. Wireless Ad hoc & Sensor networks – Jurdak – Springer -2007

NETWORK SECURITY

OBJECTIVES:

The student should be made to:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms

Unit I **9**

Introduction – Security Goals – Attacks – Services and Mechanism – Techniques

Traditional Symmetric-key ciphers: Introduction – substitution ciphers – transposition ciphers – stream and block ciphers

Unit II **9**

DES: Introduction – DES Structure – DES Analysis – Multiple DES

AES: Introduction – Transformations – Key Expansion – ciphers - Use of modern block ciphers – use of stream ciphers

Unit III **9**

Asymmetric-key Cryptography: Introduction – RSA cryptosystem – RABIN Cryptosystem

Message Integrity & Authentication: Message Integrity – Message Authentication

Unit IV **9**

Digital Signature: Comparison – process – services – attacks on digital signature – digital signature schemes - variations and applications

Entity authentication: Introduction – passwords – challenge –response – zero knowledge – biometrics

Unit V **9**

Key Management: Symmetric key distribution – Kerberos –Symmetric key agreement – Public key distribution

Security at the Transport layer: SSL Architecture – four protocols – SSL message formats – transport layer security

OUTCOMES:

At the end of the course, the student should be able to:

- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution forfunctionality at each layer
- Trace the flow of information from one node to another node in the network

Reference:

1. Cryptography & Network Security – Behrouz A Forouzan – TMH
2. Cryptography & Network Security – Stallings – PHI
3. Cryptography & Network Security – AtulKahate - TMH

CLOUD COMPUTING

OBJECTIVES:

- To understand the current trend and basics of cloud computing.
- To learn cloud services from different providers.
- To understand the collaboration of cloud services.
- To expose various ways to collaborate the cloud service online.

Unit –I **10**

Mainframe architecture-Client –Server architecture-3-tier architectures with TP monitors- Evolution of Cloud computing-Cloud computing basics-Cloud computing-SPI framework for Cloud computing-Traditional Software Model-Cloud Services Deliver Model-Cloud Deployment Models- Key Drivers to Adopting the cloud-Impact of Cloud computing on users-Governance in the Cloud-Barriers to Cloud computing Adoption in the Enterprise-Dev2.0 platforms- Dev2.0 in the cloud for Enterprises.

Unit –II **10**

Cloud platforms-Infrastructure as a service: Amazon EC2-Platform as a service: Google App Engine-Microsoft Azure- Cloud Computing Economics-Is Cloud infrastructure cheaper- Economics of Private clouds-Software productivity in the cloud-Public vs. Private clouds- Cloud Technologies- Web Services: Soap and Rest – Soap Versus Rest- AJAX: asynchronous 'rich ' interfaces-Mashups: user interface Services-Virtualization Technology- Virtual machine technology- Virtualization application in enterprises- Pitfalls of Virtualization.

Unit –III **7**

Cloud development- Relational databases-Clod file Systems: GFS and HDFS-Big Table, HBase and Dynamo, Cloud data stores: Data store and Simple DB-MapReduce and Extensions-Parallel computing- MapReduce model- Parallel Efficiency of MapReduce-Enterprise batch processing using Map Reduce.

Unit IV **10**

Dev2.0 platforms-Slaesforce.coms Force.com platform-TCS Instant Apps on Amazon cloud-More Dev 2.0 Platforms and related efforts-Advantages, applicability and Limits of Dev2.0-Anatomy of a large enterprise-Partners: people and Organizations-

Products-Orders: sales and purchase-Execution: tracking work-Billing-Accounting-Enterprise processes, build vs. buy and SaaS.

Unit V **9**

Enterprise cloud computing- Enterprise cloud computing ecosystem-Public cloud providers-Cloud management platforms and tools-Tools for building private clouds-Quick wins using public clouds-Future of enterprise cloud computing.

Outcomes:

Upon completion of the course the student will be:

- Able to collaborate the cloud services to any device.
- Exploring the online applications of cloud services.
- Able to implement cloud computing for the corporation.
- Able to design various applications by integrating the cloud services

Text Book

1. Enterprise Cloud Computing- Gautam Shroff, Cambridge University press Edition 2010 (Unit I-V)
2. Cloud Security and Privacy- Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly Edition 2009 (Unit I)

BIO INFORMATICS

Objectives:

- To prepare the students to understand the importance of Bio-Informatics and to apply the concepts in analysis of genome.

Unit 1: An Introduction – Information Search and Data Retrieval – Genome Analysis and Gene Mapping. 9

Unit 2: Alignment of Pairs of Sequences – Alignment of Multiple Sequences and Phylogenetic Analysis – Tools for Similarity Search and Sequence Alignment. 9

Unit 3: Profiles and Hidden Markov Models – Gene Identification and Prediction – Gene Expression and Microarrays. 9

Unit 4: Protein Classification and Structure Visualization – Protein Structure Prediction – Proteomics. 9

Unit 5: Computational Methods for Pathways and Systems Biology – Introduction to Drug Discovery – Drug Discovery: Technology and Strategies. 9

Outcomes:

Upon completion of the course the students will be:

- Able to describe the process of genome analysis, protein classification, etc.
- Able to analyse the given genomic sequence and classify the proteins.
- Able to design an algorithm for drug discovery

Text and Reference Books:

1. Bioinformatics , Methods and Applications – S.C.Rastogi, N.Mendiratta&P.Rastogi, PHI Learning Private Limited, Third Edition, 2010.
2. Bioinfomatics Computing – Bryan Bergeron, PHI Learning Private Limited, 2010

EVOLUTIONARY ALGORITHMS

Objectives:

- To enable the students to learn and apply the evolutionary algorithms and to analyse the efficiency among several evolutionary algorithms.

Unit 1 **8**

Introduction to Evolutionary Optimization: Unconstrained Optimization - Constrained Optimization - Multi objective Optimization - Multimodal Optimization - Combinatorial Optimization - Hill Climbing – Intelligence

Unit 2 **10**

Classic Evolutionary Algorithms

Genetic Algorithms - Evolutionary Programming - Evolution Strategies - Genetic Programming - Evolutionary Algorithms Variation

Unit 3 **9**

Recent Evolutionary Algorithms

Simulated Annealing - Ant Colony Optimization - Particle Swarm Optimization - Differential Evolution

Unit 4 **9**

Special Types of Optimization Problems

Combinatorial Optimization - Constrained Optimization

Unit 5 **9**

Multi objective Optimization

Pareto optimality - Goals of Multi-objective optimization - Non-Pareto based Evolutionary algorithms - Pareto based evolutionary algorithms

Outcomes:

At the end of the course the students will be:

- Able to describe various evolutionary algorithm
- Able to anlayse the effectiveness of evolutionary algorithm

- Able to apply the algorithms for solving the practical problems in the computing domain

Text Book:

1. Dan Simon, "Evolutionary Optimization Algorithms - Biologically Inspired and Population Based Approaches to Computer Intelligence", Wiley Publishers

Reference Book:

1. Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", Wiley Publishers

PARALLEL COMPUTING

Objectives:

To enable the students to learn about the advanced processor architectures and the programming that are done on these architecture.

Unit I – Theory of Parallelism

Elements of Modern Computers –Evolution of Computer Architecture – System Attributes to Performance - Multiprocessor and Multicomputers – Multivector and SIMD Computers –PRAM and VLSI Models –Architectural Development Tracks –Conditions of parallelism – Program Partitioning and Scheduling – System Interconnect Architectures.

Unit II – Hardware Technologies

Advanced Processor Technology – Superscalar and Vector Processors – Memory Hierarchy Technology – Virtual Memory Technology- Cache memory organizations- Shared Memory Organizations - Instruction Pipeline Design- Arithmetic Pipeline Design.

Unit III – Parallel Architectures

Multiprocessor system Interconnects – Cache Coherence and Synchronization Mechanisms – Message Passing Mechanisms – SIMD computer organizations – Connection Machine-5 Network Architecture – Principles of Multithreading – Fine Grain Multicomputers.

Unit IV – Software for Parallel Programming

Parallel Programming Models – Parallel Languages and Compilers – Code Optimization and scheduling – Loop Parallelization and Pipelining -Parallel Programming Environments – Synchronization and Multiprocessing Modes – Shared Variable Program Structures - Message Passing Program Development – Mapping Programs onto Multicomputers.

Unit V - Instruction and System Level Parallelism

Instruction Level Parallelism –Trends in Parallel Systems: Overview of Technology – Forms of Parallelism – Parallel Programming Models and Languages.

Outcomes:

At the end of the course the students will be:

- Able to describe the parallel architectures and its uses.
- Able to write a program for parallel computing.
- Apply the several parallel architecture for practical problem solving.

Text Book:

- KAI HWANG & NARESH JOTWANI “Advanced Computer Architecture Parallelism, Scalability, Programmability”, McGraw Hill, Second Edition, 2011

Reference Books:

1. Torence Fountain, Peter Kacsuk, De Zso Sigma, “Advanced Computer Architectures (A design Space approach) “, Pearson Education Asia
2. William Stallings, “Computer Organization and Architecture “Macmillan Publishing Company

NATURAL LANGUAGE PROCESSING

Objectives:

- To make the students to be competent enough to apply the NLP techniques to provide the solutions.

Unit I Introduction to NLP. Language Structure and Language Analyzer.

Unit II Words and Their Analyzer.Local Word Grouping. Paninian Grammar. Paninian Parser.

Unit III Machine Translation. Lexical Functional Grammar. LFG and Indian Languages.

Unit IV Tree Adjoining Grammar. Comparing TAG with PG.

Unit V Government and Binding. Comparing GB with PG.

Text: Natural Language Processing: A Paninian Perspective - AksharBharati, Chaitanya&Sangal – PHI -2010

Outcomes:

At the end of the course the students will be able to:

- Describe the various NLP techniques, Grammer, machine translation
- Apply the NLP concepts to provide the solutions.

References:

1. Natural Language Processing and Text mining – Anne Kao – Springer – 2011

2. Natural Language Processing – Semantic Aspects – CRC Press 2013

ROBOTICS

Objectives:

- To enable the students to learn the robotics related techniques and to apply the techniques for the real time problems.

UNIT I

LOCOMOTION AND KINEMATICS Introduction to Robotics – key issues in robot locomotion – legged robots – wheeled mobile robots – aerial mobile robots – introduction to kinematics – kinematics models and constraints – robot maneuverability.

UNIT II

ROBOT PERCEPTION Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data 68

UNIT III

MOBILE ROBOT LOCALIZATION Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments

UNIT IV

MOBILE ROBOT MAPPING Autonomous map building – occupancy grip mapping – MAP occupancy mapping – SLAM – extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fastSLAM algorithm

UNIT V

PLANNING AND NAVIGATION Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms

Outcomes:

At the end of the course the students will:

- Be able to describe the various robotics techniques.
- Be able to identify the suitable robot for the practical problems.

- Be able to analyze the various techniques.

REFERENCES:

1. Roland Seigwart, Illah Reza Nourbakhsh, and DavideScaramuzza, “Introduction to autonomous mobile robots”, Second Edition, MIT Press, 2011.
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005.
3. Howie Choset et al., “Principles of Robot Motion: Theory, Algorithms, and Implementations”, A Bradford Book, 2005.
4. Gregory Dudek and Michael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010.
5. Maja J. Mataric, “The Robotics Primer”, MIT Press, 2007
6. John J. Craig “Intoduction to Robotics Mechanics and Control”, Pearson, 2008

COMPUTER VISION

Objectives:

- To make the students to learn and understand the activities involved in the computer vision. Also to apply these techniques for the practical problems.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

APPLICATIONS: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application:

In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians

Outcomes:

At the end of the course the students will:

- Be able to describe the various activities involved in the computer vision.
- Be able to apply these techniques for the real time problems.
- To design an algorithm for the computer vision applications.

REFERENCES:

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

REAL TIME SYSTEMS

OBJECTIVE:

- To Learn real time operating system concepts and the associated issues & techniques.

UNIT I : REAL TIME SPECIFICATION AND DESIGN TECHNIQUES 9

Introduction –structure of a real time system-Task classes-Performance Measures for Real Time Systems-Estimating Program Run Times-Issues in Real Time Computing – Task Assignment and Scheduling-Classical uniproccesor scheduling algorithms-Fault Tolerant scheduling .

UNIT II :LANGUAGES AND AUTOMATA 9

Natural languages-mathematical specification –flow charts –structured charts-pseudocode and programming design languages-finite state automata-data flow diagrams-petri nets- Warnier Orr notation-state charts –polled loop systems-phase/ sate driven code-corountines –interrupt-driven systems- foreground /background systems-full featured real time operating systems.

UNIT III : INTERTASK COMMUNICATION AND SYNCHRONIZATION 9

Buffering data-mailboxes-critical regions-semaphores-deaddlock-process stack management-dynamic allocation-static schemes-response time calculation-interrupt latency-time loading and its measurement –scheduling is NP complete-reducing response times and time loading-analysis of memory requirements –reducing memory loading -I/O performance.

UNIT IV: REAL TIME DATABASES 9

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

UNIT V : EVALUATION TECHNIQUES 9

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

TOTAL : 45 PERIODS

OUTCOME:

- Understanding principles of real time systems design; be aware of architectures and behaviours of real time operating systems, database and applications.

REFERENCES:

1. C.M.Krishna,KangG.Shin,"Real-Time Systems", McGraw-Hill International Editions,1997.
2. Rajib Mall, "Real-time systems:theory and practice", Person Education, 2007
3. Stuart Bennett, "Real Time Computer Control –An Introduction", Prentice-Hall of India, 1998.
4. R.J.A Buhur,D.L Bailey," An Introduction to Real-Time Systems", Prentice-Hall Interrnational,1999.
5. Philip.A.Laplante, "Real Time Systems Desgin and Analysis", Prentice Hall of India, 3rd Edition, April 2004.
6. Allen Burns, Andy Wellings, "Real Time Systems and Programming Languages", Pearson Education, 2003.

CYBER FORENSICS

Objectives:

- To make the students to understand the importance of the cyber forensic in the current scenerios and to learn the various security mechanisms.

UNIT I - NETWORK LAYER SECURITY & TRANSPORT LAYER SECURITY

IPsec Protocol - IP Authentication Header - IP ESP - Key Management Protocol for IPsec . Transport layer Security: SSL protocol, Cryptographic Computations – TLS Protocol.

UNIT II - E-MAIL SECURITY & FIREWALLS

PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions.

UNIT III - INTRODUCTION TO COMPUTER FORENSICS

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT IV - EVIDENCE COLLECTION AND FORENSICS TOOLS

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT V - ANALYSIS AND VALIDATION

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.

Outcomes:

At the end of the course the students will be:

- Able to describe the importance of the cyber security, various security measures used for information protection.
- Able to identify the right tools for the right problem.

- Able to analyse and validate the data hiding techniques.

TEXT BOOKS:

1. Man Young Rhee, “Internet Security: Cryptographic Principles”, “Algorithms and Protocols”, Wiley Publications, 2003. 2. Nelson, Phillips, Enfinger, Steuart, “Computer Forensics and Investigations”, Cengage Learning, India Edition, 2008.

REFERENCES:

1. John R.Vacca, “Computer Forensics”, Cengage Learning, 2005
2. Richard E.Smith, “Internet Cryptography”, 3rd Edition Pearson Education, 2008.
3. MarjieT.Britz, “Computer Forensics and Cyber Crime”: An Introduction”, 3rd Edition, Prentice Hall, 2013.

INFORMATION STORAGE

Objectives:

- To enable the students to understand the concepts of storage system architecture, securing data, managing data etc.

UNIT I INTRODUCTION TO STORAGE TECHNOLOGY

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities

UNIT II STORAGE SYSTEMS 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, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system 67

UNIT III INTRODUCTION TO NETWORKED STORAGE

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need,understand the appropriateness of the different networked storage options for different application environments

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTER

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Differentiate between business continuity (BC) and disaster recovery (DR),RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, Architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their 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 to monitor for different components in a storage infrastructure, Key management tasks in a data center

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes

Outcomes:

At the end of the course the students can:

- Describe the features of the storage systems architectures, security features of storage and visualization of storage.
- Compare the features of several storage architectures and choose the efficient one based on their needs.
- Manage the operations in the data centers.

REFERENCE BOOKS:

1. EMC Corporation, Information Storage and Management, Wiley, India.
2. Robert Spalding, “Storage Networks: The Complete Reference“, Tata McGraw Hill , Osborne, 2003.
3. Marc Farley, “Building Storage Networks”, Tata McGraw Hill ,Osborne, 2001.
4. Additional resource material on www.emc.com/resource-library/resource-library.esp

INFORMATION RETRIEVAL

Objectives:

- To enable the students to learn the complexities in the information retrieval process, various information retrieval techniques, etc and to make them to design the information retrieval model.

UNIT I INTRODUCTION

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

UNIT II MODELING

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

UNIT III INDEXING

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

UNIT IV CLASSIFICATION AND CLUSTERING

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

UNIT V SEARCHING AND RANKING

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

Outcomes:

At the end of the course the students will be able to:

- Describe the various information retrieval techniques.
- Analyse the practical issues related to information retrieval.

REFERENCES:

1. Ricardo Baeza – Yates, BerthierRibeiro – Neto, Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition 2011
2. Christopher D. Manning, PrabhakarRaghavan, HinrichSchutze, Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition 2012
3. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2010

COMPUTATIONAL BIOLOGY

Objective : To make the students to understand the algorithms and machine learning techniques of computational biology. Also enable them to contribute new techniques for biological data analysis.

Unit 1: Introduction and Goals of Computational Biology – Biological Sequences: DNA, RNA, Protein – Central dogma of molecular biology - Tools and Databases of Computational Biology

Unit 2: Aligning Biological Sequences - Problem formulations – Sequence Alignment using Dynamic Programming – Multiple alignment –BLAST Algorithm – Tools and Techniques

Unit 3: Gene Expression Clustering: Clustering algorithms - Classification: Bayesian Techniques – Classification using Support Vector Machine – Tumor Classification with SVM – Semi supervised learning

Unit 4: Introduction to Biological Networks – Network centrality measures – Neural Networks – Tools and Techniques – Structural properties of Networks – Applications of Networks – Network Clustering

Unit 5: Introduction to Medical genetics – Missing Heritability – Personal Genomes - Personal Genomics – Cancer Genomics

Outcomes :

After completion of the course, the students will be

Able to describe the process of sequencing

Able to perform clustering and classification on biological data

Able to design new algorithms for biological data analysis

References:

1. Computational Biology : Genomes, Networks, Evolution - Prof.ManolisKellis,MIT ,2016
2. Introduction to Computational Biology-An Evolutionary Approach -Haubold, Bernhard, Wiehe, Thomas, Springer 2006
3. Jones, Neil, and PavelPevzner. An Introduction to Bioinformatics Algorithms. Cambridge, MA: MIT Press, 2004. ISBN: 9780262101066.
4. Duda, Richard, Peter Hart, and David Stork. *Pattern Classification*. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.

Heterogenous Wireless Network

Objective : To make the students to understand the Concept of Heterogeneous Wireless Network. To analyses the Issues in Internetworks and their behavior.

UNIT I INTRODUCION –WIRELESS NETWORKS

Migration to 3G Networks – IMT 2000 and UMTS – UMTS Architecture – User Equipment – Radio Network Subsystem – UTRAN – Node B – RNC functions – USIM – Protocol Stack – CS and PS Domains – IMS Architecture – Handover – 3.5G and 3.9G a brief discussion – 4G LAN and Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC and MAC – WiMax IEEE 802.16d/e – WiMax Internetworking with 3GPP

UNIT II: WIRELESS SENSOR NETWORKS

Unique constraints and challenges – advantages of WSNs – Sensor network applications –Collaborative processing – Key definitions of sensor networks Canonical Problem: Localization and tracing – tracking scenario – Problem formulation – distributed representation and inference of states – tracking multiple objects – sensor models – performance comparison and metrics. Networking sensors: Key assumptions – Medium access control – General issues – Geographic energy aware routing – attribute based routing. Infrastructure Establishment: Topology control – clustering – Time synchronization –Localization and localization service

UNIT III ADHOC AND HETEROGENOUS NETWORKS

Introduction to adhoc networks, characteristics features and applications. of Wireless channel Characteristics, Adhoc Mobility Models:- Indoor and outdoor mobility models, Entity Vs Group mobility models. Handover– basic definition, Handover Characteristics –Hard and Soft handover-Handovermechanisms.Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing,Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithms, Energy aware routing algorithms, Hierarchical Routing, QOS aware routing.

UNIT-IV LED LIGHT COMMUNICATIONS: TOWARDS NETWORKED LI-FI

Introduction Histroy of OWC-Advantages-Application areas. Introduction of Li-Fi-Terminologies .Challenges of OWC.OWC-Comminicationscenarios,optical Front-

ends,optical wireless channel. Cellular network :Case study in an aircraft cabin.Front-end non-Linearity

UNIT-V VLC MODULATION SCHEMES

Digital Modulation Schemes-optical signals, Single carrier, Multicarrier.Spectral efficiency and information rate- Constraints –Modulation schemes with AWGN.Information rate of OFDM-based with non-linear distortion.Modulation Schemes in the dispersive channel with AWGN.MIMO Transmission-System model-Techniques-BER performance.Throughput of Cellular OWC networks-Introduction-System throughput-Interference coordination in optical cells-System throughput with busy burst and fair reservation mechanism.

OUTCOMES: After completion of the course, the students will be able to Frame a Hetero generous network ,their communication and explore its performance characteristics.

Reference

1. C.Siva Ram Murthy and B.S.Manoj, Adhoc Wireless Networks Architectures and
   protocols, 2nd edition, Pearson Education.
2. Pei Zheng and Lionel M Li, 'Smart Phone & Next Generation Mobile Computing', Morgan Kaufmann Publishers, 2006.
3. Charles E. Perkins, Ad hoc Networking, Addison – Wesley
4. Wireless Sensor networks : Feng Zhao,LeonidasGuibas –Morgan Kaufmann Publications – 2012.
5. Fundamentals of Wireless sensor networks Theory and Practice – WaltenegusDargie, Christian Poellabauer – Wiley – 2010
6. Principles of LED Light Communications: Towards Networked Li-Fi, SvilenDimitrov, Harald Haas

LED Light Communications: Towards Networked Li-Fi

Objective : To make the students to understand the basic learning techniques of Visual light Communication (VLC). The Evolution of Li-Fi Technology and its Channel model is explored. The physical Characteristics and its behavior of Modulation Techniques in communication is detailed .To learn about the Li-Fi Networked environment.

Unit-1

Introduction

Histroy of OWC-Advantages-Application areas. Introduction of Li-Fi-Terminologies .Challenges of OWC.

Unit-2

OWC-Comminicationscenarios,optical Front-ends,optical wireless channel.Cellular network :Case study in an aircraft cabin.Front-end non-Linearity

Unit-3

Digital Modulation Schemes-optical signals, Single carrier, Multicarrier.Spectral efficiency and information rate- Constraints –Modulation schemes with AWGN.Information rate of OFDM-based with non-linear distortion.Modulation Schemes in the dispersive channel with AWGN

Unit-4

MIMO Transmission-System model-Techniques-BER performance

Unit-5

Throughput of Cellular OWC networks-Introduction-System throughput-Interference coordination in optical cells-System throughput with busy burst and fair reservation mechanisum.

Outcomes:

After completion of the course, the students will be able to Frame a networked Li-Fi and explore its performance characteristics.

References

1.Principles of LED Light Communications: Towards Networked Li-Fi,
SvilenDimitrov, Harald Haas

Remote Sensing and GIS

Course Objective:

To provide required research insights related to Remote Sensing and GIS.

Unit 1: Basic concepts of remote sensing-Basic EMR radiation and its interactions with atmosphere and earth-Aerial photography and photo grammetry.

Unit 2: Photo geology-Visual interpretation of aerial photographs-Remote sensing platforms-Remote sensing in solar reflection region-Classification accuracy assessment and errors-digital change detection analysis.

Unit 3: Microwave remote sensing and its applications-Thermal remote sensing and its applications-Hyper spectral remote sensing and its applications.

Unit 4: Applications of remote sensing in geology-Environmental applications of remote sensing-Concepts of GIS-GIS data structure; Raster Vs vector-Map Projection-GIS database creation.

Unit 5: Digital cartography verses geographical information system-Concepts of global navigation satellite system-GIS-GPS integration-applications in earth system science-Integration of remote sensing, GIS and GPS.

Course Outcome:

The Students will understand

- the basic concepts of Remote Sensing
- various remote sensing applications
- Introduction to GIS and GPS
- Integration of remote sensing with GIS and GPS

E-Resource:

https://epgp.inflibnet.ac.in/ahl.php?csrno=448 [e-PG Pathshala(NME-ICT)]

Additional Resources:

1.Lillesand Thomas,Keifer RalphW.and Chipman Jonathan (2015),Remote sensing and Image Interpretation, 7thEdn.,John Wiley & Sons, New York.ISBN : 978-1-118-34328-9

2.Campbell, James B. and Wynne, Randolph H. (2011). Introduction to Remote sensing, 5thEdn. The Guliford Press, New York, USA. ISBN: 160918176X, 978-1609181765

3.Reddy,Anji M. (2012), Textbook of remote sensing and geographical information systems, 4thEdn., BS Publications. ISBN: 9381075972, 978-9381075975.

DEEP LEARNING

L T P C

4 0 0 4

Objectives:

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolution neural networks. The course also requires students to implement programming assignments related to these topics.

UNIT I

Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm. Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.

UNIT II

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.

UNIT III

Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT IV

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

Unit V

Recent trends: Variationa lAutoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

TOTAL PERIODS: 60

OUTCOMES:

- Deep learning is a set of student educational outcomes.
- Including acquisition of robust core academic content, higher-order thinking• skills, and learning dispositions.

Textbooks

1.Deep Learning, Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press, 2016.

References:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996 2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007