BHARATHIAR UNIVERSITY: COIMBATORE 641046
M. Phil. / Ph.D. – COMPUTER SCIENCE

PART I – SYLLABUS
(For the candidates admitted from the academic year 2018-19 onwards)

PAPER I - RESEARCH METHODOLOGY

PAPER II - ADVANCED TECHNOLOGIES IN COMPUTER SCIENCE

PAPER III
1. DATA WAREHOUSING AND MINING.
2. DIGITAL IMAGE PROCESSING.
3. ADVANCED NETWORKING.
4. NATURAL LANGUAGE PROCESSING.
5. DATA COMPRESSION.
6. AGENT BASED COMPUTING.
7. SOFT COMPUTING.
8. SOFTWARE TESTING AND QUALITY ASSURANCE.
9. KNOWLEDGE MANAGEMENT AND BUSINESS INTELLIGENCE.
10. GRID AND CLOUD COMPUTING.
11. ARTIFICIAL INTELLIGENCE AND ROBOTICS.
12. BIOINSPIRED COMPUTING.
13. CONCURRENT ENGINEERING INFORMATION SYSTEM.
14. SPEECH PROCESSING.
15. INFORMATION SECURITY.

PAPER I - RESEARCH METHODOLOGY

UNIT – I RESEARCH METHODS

Meaning of Research- Objectives of Research- Motivation in Research- Types of Research- Research Approaches- Significance of Research-research methods versus Methodology-Research and Scientific Method- Importance of Knowing How Research is done- Research Process – Criteria of good Research –Problem Encountered by Researchers in India- What is Research Problem? Selecting the Problem- Necessity of Defining the Problem- Technique involved in Defining the Problem- Meaning of Research Design- Need for Research Design- Features of a Good Design- Important Concepts Relating to Research Design- Different research design- Basic principles of Experimental Designs- Significance of Report Writing- Different Steps in writing Report- Layout of the Research Report- Types of Reports- Oral Presentation Mechanics of Writing a Research Report- Precautions for Writing Research Reports.

UNIT – II ALGORITHMS AND ANALYSIS

Elementary data Structures, Greedy method: Knapsack problem-job sequencing with deadlines-Optimal merge patterns, Dynamic Programming: Multistage graphs-Optimal binary search trees-0/1 knapsack- Reliability design- The traveling salesperson problem- Flow shop scheduling, Basics search and traversal techniques: The techniques Code Optimization- Biconnected components and depth- first search. Backtracking: The 8 – Queer s problem- Sum of subsets – Hamiltonian cycles-Knapsack Problem.

UNIT – III COMPILER DESIGN

Introduction to compiling- The Phases of a Compiler- Lexical Analysis- The role of the lexical analyser-Specification &Recognition of tokens- Finite Automata-Conversion of Regular Expression to NFA – Syntax Analysis- The Role of the Parser-Context Free Grammar- Top-Down Parsing: Predictive Parser- Bottom- Up Parsing: SLR Parser Syntax- Directed Translation-Type Checking- Specification of a simple type checker -Type Conversion- An algorithm for Unification- Symbol tables- Intermediate Code Generation-Code Generation- Issues in the design of code generator- Basic Blocks and Flow Graphs- Code Optimization- The Principal sources of optimization-optimization of basic blocks.

UNIT – IV OBJECT ORIENTED ANALYSIS, DESIGN AND DEVELOPMENT

Object Oriented Design Fundamentals: The Object Model - Classes and Objects - Complexity - Classification - Notation - Process - Pragmatics – binary and entity relationship - object types - object state - OOSD life cycle. Object Oriented Analysis: Overview of object analysis - Shatter/Mellor, Coad/Yourdon, Rumbaugh, Booch - UML – Use case model– Conceptual model - behavior - class - analysis patterns - overview - diagrams - aggregation. Object Oriented Design Methods: UML - diagrams - collaboration - sequence - class - design patterns and frameworks - comparison with other design methods. Managing Object Oriented Development: Managing analysis and design - Evaluation testing - coding - Maintenance - Metrics. Object Oriented Development: Design of Foundation class libraries - Object Oriented Databases - Client/Server Computing - Middleware.

UNIT – V SOFTWARE ENGINEERING

Software Engineering Process paradigms - Project management - Process and Project Metrics – software estimation - Empirical estimation models - planning - Risk analysis - Software project scheduling. Requirements Analysis and Design: Prototyping - Specification - Analysis modeling - Software design - Abstraction - Modularity - Software Architecture - Effective modular design - Cohesion and Coupling - Architecture design and Procedural design - Data flow oriented design-design patterns. User interface design - Human Computer Interface design - Interface design - Interface standards. Programming languages and coding - Language classes - Code documentation – Code efficiency - Software Configuration Management – real time systems-Reverse Engineering and Re-engineering-CASE tools - Projects management, tools - analysis and design tools - Programming tools - integration and testing tools – clean room software engineering.

REFERENCE BOOKS:

1. C.R.Kothari,"Research Methodology Methods & Techniques" 2nd Edition, Wishwa Prakashan Publishers.
2. Dr.Rajammal P. Devadas,"A. Handbook on Methodology of Research-Sri Ramakrishna Mission Vidyalaya College of Rural Higher Education".
3. Alfre V. Aho, John E. Hcpcroft, Jeffrey D. Ullman," Data structures and Algorithms", Addison- Wesley Publishing Company, 1987.
4. Ellis Harowitz, Sartaj Sahini, "Compute Algorithms", Galgotia Publications (P) Ltd., 1993.
5. Alfre V. Aho, Ravi Sethi and Jeffrey D. Ullman," Compiler Principles, Techniques and Tools", Addison Wesley Publishing Co,1986.
6. Jean Paul, Tremblay, Paul G. Sorenson, "The Theory and Practices of Compiler Writing" Mc. GrawHill Inc, International Student Edition, 1985.
7. Craig Larman, "Applying UML and patterns ", Addison Wesley, 2000.
8. Grady Booch, James Rumbaugh, Ivar Jacobson," The Unified Modeling Language
9. User Guide ", Addison-Wesley Long man, 1999.
10. Ali Bahrami, "Object Oriented System Development ", McGraw Hill International Edition, 1999.
11. Erich Gamma, "Design Patterns ", Addison Wesley, 1994.
12. Roger Pressman.S., " Software Engineering : A Practitioner's Approach ", 3rd Edition, McGraw Hill, 1997.
13. P Fleeger, "Software Engineering ", Prentice Hall, 1999.
14. Carlo Ghezzi, Mehdi Jazayari, Dino Mandrioli "Fundamental of Software Engineering ", Prentice Hall of India 1991.

PAPER II - ADVANCED TECHNOLOGIES IN COMPUTER SCIENCE

UNIT – I TCP/IP

TCP/IP Protocol suite – Addressing – Classful addressing – Addressing issues – Subnetting and Supernetting – Variable length blocks – Packet delivery – Forwarding – Routing – ARP and RARP – Internet Protocol – ICMP – IGMP – UDP – TCP – Flow Control – Error Control – Congestion Control – Intra and Inter Domain Routing – Distance Vector Routing – Link State Routing- Path Vector Routing – Multicast Routing – BOOTP – DHCP – DNS – Remote Login and Telnet – FTP and TFTP – Electronic Mail – Network Management – IPV6.

UNIT – II ADAPTIVE WEB TECHNOLOGY

J2ee: Overview-Multi-tier Architecture-the Enterprise Application-Clients-Sessions Management-Web Tier-EJB Tier-J2ee Web Services, Technologies, Components .NET Framework – Architecture-Design Principles- Alternative Implementations Networking-Remoting-Security, Building Web Applications-Webservices-Characteristics-Architecuture-Components-Security,Standards. Overview of xml.

UNIT - III BIG DATA ANALYTICS

Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL- Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce- Big data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders. The Evolution of Big Data-Big Data: The Modern Era- Bringing It All Together-The Path to Big Data-The Realities of Thinking Big Data-Hands-on Big Data-The Big Data Pipeline in Depth-Big Data Visualization-Big Data Privacy.

UNIT IV- INTERNET OF THINGS

Introduction to IoT – Physical and Logical Design of IoT – Enabling Technologies of IoT – IoT Devices – Pillars of IoT: M2M, RFID, WSN, SCADA – Connection and Management of IoT Devices – IoT Applications: Intelligent Transport – Smart Grid – Smart Buildings.

UNIT V - NoSQL DATABASES

Introduction to NoSQL, Aggregate Data Models - Aggregates - Key - Value and Document. Data models – Column Family stores - Relationships - Graph databases – Schemaless databases - Materialized views. Distribution data models - Single server - Sharding - Master - slave replication – Peer-to peer replication. Consistency - Update consistency - Read consistency - Relaxing consistency - CAP theorem - Version stamps - Business and system Transactions - Version stamps on multiple nodes. MapReduce - Basic MapReduce - Partitioning and combining - Composing MapReduce calculations. Implementation - Key value databases - Document databases - Column Family stores - Graph databases.

Reference Book:

1. Behrouz A. Forouzan, “TCP/IP Protocol Suite”, 3rd Edition, Tata McGraw –Hill, 2008
2. Jim Keogh," The Complete Reference J2EE", Tata McGraw-Hill Edition,2002.
3. James McGovern et al.,"J2EE1 .4 Bible", Wiley Publishing Inc,2003.
4. Visual studio .Net Walkthroughs- Microsoft Manual.
5. www.msdn.microsoft.com/netframework.
6. Nina Zumel, John Mount “Practical Data Science with R”, Manning Publications, 2014.
7. Frank J. Ohlhorst**, “**Big Data Analytics: Turning Big Data into Big Money”, Wiley India Pvt. Ltd,ISBN: 978-1-118-14759-7, Nov 2012
8. Dr. Radha Shankarmani, “*Big Data Analytics”*, 2nd Edition, Wiley Publication, 2018 Wiley India Pvt. Ltd. ISBN: 9788126565757.
9. Vignesh Prajapati, *Big Data Analytics with R and Hadoop*, Copyrigh 2013, Packt Publishing, published by Packt Publishing Ltd. Livery Place,35 Livery Street, Birmingham B3 2PB, UK. ISBN 978-1-78216-328-2.
10. Honbo Zhou, “The Internet of Things in the Cloud – A Middleware Perspective”, CRC Press, 2016.
11. ArshdeepBahga, Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press, 2015.
12. Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, Pearson Education, 2012
13. Dan Sullivan, NoSQL for Mere Mortals, 1st Edition, Pearson Education, 2015.
14. Shashank Tiwari, Professional NoSQL, John Wiley & Sons, 2011

PAPER III – 1. DATA WAREHOUSING AND MINING

UNIT - I Data Warehousing Introduction – Definition - Architecture - Warehouse Schema - Warehouse server OLAP operations. Data Warehouse technology – Hardware and operating system - Warehousing Software - Extraction tools – Transformation tools – Data quality tools – Data loaders – Data Access and retrieval tools – Data Modeling tools – Fact tables and dimensions. Data warehousing case studies: Data warehousing in Government, Tourism, Industry, Genomics data. Information Retrieval - Introduction – Role of IR – Information Retrieval systems - IR Applications Areas – IR Algorithms – Retrieval algorithms – Filtering algorithms – Indexing algorithms - Evaluation in Information Retrieval.

UNIT - II Data Mining definition – DM Techniques – current trends in data mining - Different forms of Knowledge – Data selection, cleaning, Integration, Transformation, Reduction and Enrichment. Data: Types of data - Data Quality - Data Preprocessing - Measures of similarity and dissimilarity. Exploration: Summary statistics – Visualization.

UNIT – III Association rules: Introduction – Methods to discover association rule – Apriori algorithm Partition Algorithm – Pincher search algorithm – Dynamic Item set algorithm – FP Tree growth algorithm. Classification: Decision Tree classification – Bayesian Classification – Classification by Back Propagation.

UNIT - IV Clustering Techniques: Introduction – Clustering Paradigms – Partitioning Algorithms – K means & K Mediod algorithms – CLARA – CLARANS – Hierarchical clustering – DBSCAN – BIRCH – Categorical Clustering algorithms – STIRR – ROCK – CACTUS. Introduction to machine learning – Supervised learning – Unsupervised learning – Machine learning and data mining. Neural Networks: Introduction – Use of NN – Working of NN Genetic Algorithm: Introduction – Working of GA.

UNIT - V Web Mining: Introduction – Web content mining – Web structure mining – Web usage mining – Text mining – Text clustering, Temporal mining - Spatial mining – Visual data mining – Knowledge mining – Case Studies using R and Python - Analysis and Forecasting of House Price Indices, Customer Response Prediction and Profit Optimization, Predictive Modeling of Big Data with Limited Memory, Twitter Information Diffusion.

REFERENCE BOOKS:

1. C.Charu Agarwal, "Data Mining : The Text Book ", Springer, 2015.
2. Han, Jiawei, Jian Pei, and MichelineKamber, “Data mining: concepts and techniques”, 3rd Edition, Elsevier, 2011.
3. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education, 2012.
4. Bing Liu, “Web Data Mining: Exploring Hyperlinks, Content, and Usage Data”, 2 nd Edition, Springer, 2011.
5. Christopher D.Manning, Prabhakar Raghavan and Hinrich Schütze, “Introduction to Information Retrieval”, Cambridge University Press. 2008.
6. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, “Introduction to Data Mining”, 2007.
7. Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", MIT Press, 2010.

8. Yanchang Zhao, “R and DataMining: Examples and Case studies” Elsevier Publication, 2015.
9. Yanchang Zhao, Yonghua Cen, “Data Mining Applications with R” Elsevier Publication. 2013.
10. Layton Robert, "Learning Data Mining with Python", Packt Publishing, 2011.
11. Finn Arup Nielsen, "Data Mining with Python" (working draft). Technical University of Denmark, 2017.

PAPER III – 2. DIGITAL IMAGE PROCESSING

UNIT – I

Digital Image Processing: Origins of Digital Image Processing, Steps in Digital Image Processing, Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels, Mathematical Tools used in Digital Image Processing.

UNIT – II

Image Transformation & Filters: Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filter, Sharpening Spatial Filters, Combining Spatial Enhancement methods, Fuzzy techniques for Intensity Transformation and Spatial Filtering. Fuzzy Similarity Measure, Measure of Fuzziness, and Entropy, Thresholding Detection in Fuzzy Images, Fuzzy Match-based Region Extraction, Fuzzy Edge Detection, Fuzzy Content-Based Image Retrieval. Filtering in the Frequency Domain: Preliminary Concepts, Sampling and the Fourier Transforms of Sampled Functions, The Discrete Fourier Transform (DFT), Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Sharpening using Frequency Domain Filters, Selective Filtering.

UNIT – III

Image Restoration, Reconstruction and Image Segmentation: Image Degradation/Restoration process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Functions, Inverse Filtering, Wiener Square Error Filtering, Constrained Least Square Filtering, Geometric Mean Filter, Image Reconstruction from Projections. Image Segmentation: Point, Line and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation.

UNIT - IV

Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Full Color Image Processing, Color Transformation, Smoothing and Sharpening, Image Segmentation Based on Color, Noise in Color Images. Wavelets and Multiresolution Processing: Multiresolution Expansion, Wavelet Transforms in One Dimension, The Fast Wavelet Transforms, Wavelet Transforms in Two Dimensions, Wavelet Packets. Image Compression: Fundamentals, Basic Compression Methods, Digital Image Watermarking.

UNIT – V

Morphological Image Processing: Erosion and Dilation, Opening and Closing, The Hit-Or-Miss Transformation, Basic Morphological Algorithms, Gray-Scale Morphology. Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Relational Descriptors. Object Recognition: Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.

REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2012.
2. Tamalika Chaira and Ajoy Kumar Ray, " Fuzzy Image Processing and Applications with MATLAB", CRC Press, 2017.
3. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing using MATLAB",2nd Edition, Mcgraw Higher Education, 2010.
4. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Educationa, First Edition, 2015

PAPER III – 3. ADVANCED NETWORKING

Unit I

Telecommunication systems:

GSM services – subsystem – system architecture - Handover - DECT system architecture – TETRA – UMTS system architecture – UTRAN – CDMA2000 - GPRS : system architecture – 802.11 system architecture - Bluetooth system architecture – IrDa protocol – ZigBee architecture - HSPA

Unit II

ADHOC Wireless Network :

Ad Hoc Wireless Network –MAC protocol – issues in MAC protocol – Routing protocols – issues in Routing protocol - Transport Layer Protocol -issues in transport protocol - QOS – Energy Management – Security in Adhoc network

Unit III

Wireless Sensor Network :

Architecture and Design – Medium Access Control – Routing – Transport Layer – power management – sensor localization – clock synchronization - Energy model Issues in wireless sensor network.

Unit IV

LTE and Advanced LTE pro – network architecture and interface – FDD air interface and radio network TD LTE air interface – network sharing – MOCN – MORAN - LTE security architecture – scheduling - VoLTE –VoWifi – Mission critical communication

Unit V

5G Technologies – overview – Non Orthogonal Multiple Access for 5G Systems Millimeter Wave Communications for 5G Networks – Visible Light Communication in 5G – Massive MIMO Scheduling Protocols – Cellular 5G Access for Massive Internet of things.

REFERENCE BOOKS:

1. Jochen Schiller , Mobile Communication, Pearson, Second Edition, 2009.
2. Fei Hu and Xiaojun Cao, " Wireless Sensor Networks Principles and Practice " CRC Press, 2010.
3. C.Siva Ram Murthy and B.S. Manoj, Ad Hoc Wireless Networks – Architectures and Protocols, Pearson Education, Second Edition
4. Martin Sauter,"From GSM to LTE Advanced PRO and 5G – An Introduction to Mobile Network and Mobile Broadband", Third edition, Wiley, 2017.
5. Vinod W Wrong , Robert Schober, Derrick Wing Kwanng mLi Chun Wang, Key Technologies for 5G Wireless Systems, Cambridge University Press, 2017

PAPER III – 4. NATURAL LANGUAGE PROCESSING

UNIT - I Natural Language Processing (NLP) – open problems – major goal – language structure – language analyzer – morphological analyzer – local world grouper (LWG) – core parser – requirements of computational grammars – computational aspect – system aspect – large system aspect – morphological analysis – morphological generation using paradigms – morphological analysis using paradigms – speeding up morphological analysis by compilation – morphological analyzer – additional issues – local word grouping – verb groups – noun groups – strategy for grammar development – semantics in stages.

UNIT - II Paninian grammar – semantic model – free word order and vibhakti – paninian theory – karaka relations – active passive – control – karaka to vibhakti mapping – karaka sharing.

UNIT - III Machine translation – survey – is MT possible? – Possible approaches – current status – anusaraka or language accessor – cutting the Gordian knot – structure of anusaraka systems – user interface – linguistic area – anusaraka output – language bridges.

UNIT - IV Lexical functional grammar – active passive and dative constructions – WH movements in questions – LFG formalism – well formedness conditions – handling WH movements in questions – computational aspects – features and feature structures – unification – other constraints – CFG and Indian languages – functional specification – lexicalized grammars and locality – lexicalized tree substitution grammar – lexicalized tree adjoining grammar – feature structures – mathematical aspects.

UNIT - V Comparing TAG with PG – similarities between TAG and PG – differences between TAG and PG – Government and binding – GB modules – X-bar theory – theta theory – Government – Case theory – bounding theory – empty category principle (ECP) – binding theory – constraints on movement – GB parsing – comparing GB with PG.

REFERENCE BOOKS:

1. Akshar Bharati, Vineet Chaitanya, Rajeev Sangal, "Natural Language Processing – A Paninian
   Prespective", Prentice Hall of India, 2000.

2. James Allen, Natural Language Understanding, 3rd Edition, Pearson Education, 2005.

PAPER III – 5. DATA COMPRESSION

UNIT - I Compression Techniques – Lossy compression & Lossless compression, modeling and compression Mathematical modeling for Lossless compression- Physical models, probability models, Markov Models and composite source models. Mathematical modeling for Lossy compression – physical models, Probability and linear systems models.

UNIT - II Basic Techniques: Run length encoding, RLE Text compression, RLE image compression and scalar quantization. Statistical Methods : Information theory concepts, Huffman coding, Adaptive Huffman coding facsimile, compression Arithmetic coding and Adaptive, Arithmetic coding and Text compression. Dictionary methods: String compression, LZ 77, LZSS, LZ78,LZW, Unix compression, GIF image, ARC and PKZIP, Data compression patterns. Wavelet methods: Fourier Image compression, Multi Resolution decomposition and JPEG 2000.

UNIT - III Intuitive Methods, Image Transforms, JPEG, Progressive Image compression, Vector quantization, Adaptive Vector Quantization, Block Matching, Block Truncation coding. Context Tree weighting, Block Decomposition, Binary Tree predictive coding, Quad Trees and Finite Automata Methods.

UNIT - IV Analog Video, Composite and Components Video, Digital Video, Video compression, MPEG and H.261.

UNIT - V Sound, Digital Audio, The Human Auditory System, μ -Law and A-Law companding, ADPCM Audio compression and MPEPG-1 Audio Layers.

REFERENCE BOOKS:

1. David salomon ,"Data compression – The complete Reference",2nd Edition, Springer publications.
2. Mark Nelson and Jean-Loup Gailly," The Data compression Book", 2nd Edition, BPB publications.
3. Khalid Sayood, "Introduction to Data Compression", Harcout India(P) Ltd, New Delhi .

PAPER III – 6. AGENT BASED COMPUTING

UNIT - I Introduction to Software Agents: What is a software agent? - Why software agents? - Applications of Intelligent software agents-Practical design of intelligent agent systems.

UNIT - II Intelligent Agent Learning- Approaches to Knowledge base development-Disciple approach for building intelligent agents- Knowledge representation-Generalization-Problem solving methods-Knowledge elicitation.

UNIT - III Rule learning: Rule learning problem- Rule learning method- Learned rule characterization. Rule refinement: Rule refinement problem- Rule refinement method- Rule experimentation and verification-Refined rule characterization-Agent interactions.

UNIT - IV Disciple shell: Architecture of Disciple shell- Methodology for building Intelligent Agents- Expert-Agent interactions during knowledge elicitation process- Expert-Agent interactions during rule learning process- Expert-Agent interactions during rule refinement process.

UNIT - V Case studies in building intelligent agents: Intelligent Agents in portfolio management-Intelligent Agents in financial services. Java Agent Development framework [JADE]: Creating multi-agent systems with JADE- Agent platform- Agent Tasks and behaviors-Agent Communication Language - Interaction protocols- Using JADE from Java.

REFERENCE BOOKS:

1. Jeffrey M Bradshaw, “Software Agents”, AAAI Press/ The MIT Press, 2000.
2. Nicholas R Jennings, Michael J Wooldridge (Eds.), “Agent Technology – Foundations,Applications and Markets”, Springer, 1997.
3. GheorgheTecuciet al., “Building Intelligent Agents”, Academic Press, 2003.
4. Eduardo Alanso, Daniel Kudenko, Dimitar Kazakov (Eds.), “Adaptive Agents and Multi-AgentSystems”, Springer Publications, 2003.
5. jade.tilab.com/doc/programmersguide.pdf.

PAPER III – 7. SOFT COMPUTING

UNIT – I

Fundamentals of ANN: The Biological Neural Network, Artificial Neural Networks - Building Blocks of ANN and ANN terminologies: architecture, setting of weights, activation functions - McCulloch-pitts Neuron Model, Hebbian Learning rule, Perception learning rule, Delta learning rule.

UNIT - II

Models of ANN: Single layer perception, Architecture, Algorithm, application procedure - Feedback Networks: Hopfield Net and BAM - Feed Forward Networks: Back Propagation Network (BPN) and Radial Basis Function Network (RBFN) - Self Organizing Feature Maps: SOM and LVQ – implementing Neural Networks using Python

UNIT - III

Fuzzy Sets, properties and operations - Fuzzy relations, cardinality, operations and properties of fuzzy relations, fuzzy composition - Fuzzy variables - Types of membership functions - fuzzy rules: Takagi and Mamdani – fuzzy inference systems: fuzzification, inference, rulebase, defuzzification.

UNIT – IV

Genetic Algorithm (GA): Biological terminology – elements of GA: encoding, types of selection, types of crossover, mutation, reinsertion – a simple genetic algorithm – Theoretical foundation: schema, fundamental theorem of GA, building block hypothesis.

UNIT - V

Deep Feedforward Networks - Regularization for Deep Learning - Optimization for Training Deep Models - Convolutional Networks - Sequence Modeling: Recurrent and Recursive Nets - Autoencoders - Deep Generative Models - Applications of Deep Learning – Deep Learning using TensorFlow (Python)

REFERENCE BOOKS:

1. S. N. Sivanandam, S. Sumathi, S.N. Deepa, “Introduction to Neural Networks using MATLAB 6.0“, Tata McGraw-Hill, New Delhi, 2006.
2. S. N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, Wiley-India, 2008.
3. Tariq Rashid, ‘Make Your Own Neural Network’, CreateSpace Independent Publishing Platform, 2016.
4. D.E. Goldberg,”Genetic algorithms, optimization and machine learning”, Addison Wesley 2000.
5. Ian Goodfellow, Yoshua Bengio and Aaron Courville, 'Deep Learning', MIT Press, 2016
6. Bharath Ramsundar and Reza Bosagh Zadeh, ‘TensorFlow for Deep Learning’, O’Reilly Media, Inc, 2018.

PAPER III – 8. SOFTWARE TESTING AND QUALITY ASSURANCE

UNIT - I Testing Objectives and principles - Purpose of Software testing – SDLC and testing – Verification and validation - Weyuker's adequacy axioms – model for testing and consulting oracles – Is complete testing possible – The Consequence of bugs – Taxonomy of Bugs– Test case Design – Black Box Testing and White Box testing – Testing strategies - Unit testing – Integration Testing – Validation testing – System testing – The art of Debugging and debugging approaches.

UNIT - II Basis Path testing - Data flow testing - Control flow and structure testing– Strategies – Applications, Tools and effectiveness – Condition Testing -Transaction Flow testing, Syntax Testing – Grammar for formats – Implementation. Loop and Logic Based Testing – Decision tables – Path Expressions – KV Charts – Specifications – State transition Testing – identifying good & bad states – state testing Metrics and Complexity.

UNIT - III Graph based testing methods –Orthogonal Array testing –Performance Testing - Testing for Real-time Systems– issues – Testing in web applications – Testing in object oriented software - Differences from testing non-OO Software – Testing OOA and OOD models -Class testing strategies - Class Modality - State-based Testing - Message Sequence Specification.

UNIT - IV Automated Tools for Testing - Static code analyzers - Test case generators - GUI Testing -Capture/Playback – Stress Testing - Testing Client -server applications - Testing compilers and language processors - Testing web enabled applications. Design for Testability - Observability & Controllability - Built-in Test - Design by Contract - Precondition, Post condition and Invariant - Impact on inheritance – polymorphism.

UNIT - V Regression Testing - Challenges – Test optimization- Mutation testing – Fault based testing –Scenario based testing-penetration testing-Testing Approaches in Software Industry – testing metrics – function based metrics –Bang metrics – software quality metrics.

REFERENCE BOOKS:

1. Boris Beizer," Software Testing Techniques", 2nd Edition, Dreamtech Press, 2003.
2. Myers, Glenford.J., "The Art of Software Testing",John-Wiley &Sons,1979.
3. Roger.S.Pressman, "Software Engineering –A Practitioner's Approach",5th Edition,Mc-Graw Hill, 2001.
4. Marnie.L. Hutcheson, "Software Testing Fundamentals", Wiley, 2007.
5. William E.Perry, "Effective Methods for Software Testing ", 2nd Edition, John Wiley & Sons, 2000.
6. Robert V.Binder, "Testing Object-Oriented Systems: Models Patterns and Tools ", Addison
   Wesley, 2000.

PAPER III – 9. KNOWLEDGE MANAGEMENT AND BUSINESS INTELLIGENCE

UNIT – I

Basics - What is Knowledge Management? - Definitions - Cognition and Knowledge Management - Data, Information, and Knowledge - Types of Knowledge, Knowledge Management System Life Cycle - Challenges in Building KM Systems - Conventional Versus KM System Life Cycle - KM System Life Cycle - System Justification - Role of Rapid Prototyping - Role of Knowledge Developer.

UNIT - II

Knowledge Creation - Nonaka's Model of Knowledge Creation and Transformation - Knowledge Architecture - Capturing Tacit Knowledge – Evaluating the Expert – Developing a relationship with Expert – Interview as a tool – Brainstorming – Repertory Grid - Nominal-Group Techniques(NGT) – Delphi method – Concept mapping Knowledge Codification - Codification Tools and Procedures - Knowledge Developers Skill Set - Knowledge Transfer - Transfer Methods - Portals Basics - Business Challenge - Knowledge Portal Technologies.

UNIT-III

Changing Business Environments and Computerized Decision Support - A Framework for Business Intelligence - Intelligence Creation and Use and BI Governance - Transaction Processing versus Analytic Processing - Successful BI Implementation - Major Tools and Techniques of Business Intelligence.

UNIT - IV

Implementing BI: An Overview - BI and Integration Implementation - Connecting BI Systems to Databases and Other Enterprise Systems - On-Demand BI - Issues of Legality, Privacy, and Ethics - Emerging Topics in BI: An Overview - The Web 2.0 Revolution - Online Social Networking: Basics and Examples - Virtual Worlds - Social Networks and BI: Collaborative Decision Making - RFID and New BI Application Opportunities - Reality Mining.

U**NIT –V**

The Context of Data Visualization: Exploiting the digital age-Visualization design objectives,Demonstrating Editorial Focus and Learning About Your Data: The importance of editorial focus-An example of finding and telling stories,Conceiving and Reasoning Visualization Design Options: Data visualization design is all about choices-The visualization anatomy – data presentation, Taxonomy of Data Visualization Methods: Data visualization methods-Choosing the appropriate chart type.

REFERENCE BOOKS:

1. Elias M.Awad, Hassan M.Ghaziri,"Knowledge Management", Pearson Education, 2004, (For Units I, II and III).
2. Efraim Turban, Ramesh Sharda, DursunDelen and David King, "Business Intelligence" 2nd Edition, 2015. (For Unit III – Chapter 1, Unit – IV -Chapter 6).
3. Andy Kirk, "Data Visualization: a successful design process" Packt Publishing Ltd. First published: December 2012 (For Unit V – Chapters 1, 3,4,5)

4. Chun-houh Chen, Wolfgang Hardle, Antony Unwin, "Handbook of Data Visualization" Springer-Verlag Berlin Heidelberg, 2008.
5. Daniel G. Murray andthe InterWorks BI Team, "Tableau Your Data!"Published byJohn Wiley &Sons, Inc., 2013.

PAPER III – 10 GRID AND CLOUD COMPUTING

UNIT - I

Introduction – Examples of Distributed Systems – Resource Sharing and the Web – Challenges. System Models - Introduction – Architectural Models – Functional Models Characterization of Distributed Systems – Client-Server Communication – Distributed Objects and Remote Invocation – Communication Between Distributed Objects – Remote Procedure Call – Events and Notifications.

UNIT - II

Introduction to GRID Computing - How Grid Computing Works, Grid Middleware, Grid Architecture, Types of Grids Grid Computing Applications, Simulators SOA: Basic SOA Definition, Overview of SOA, SOA and Web Services, Service Oriented Grid, SOA Design and Development, Advantages and Future of SOA Grid computing, Cloud and SOA.

UNIT – III

Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS. Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.

UNIT – IV

Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Mapreduce, Features and comparisons among GFS,HDFS etc, Map-Reduce model.

UNIT – V

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control, identity management, Access control, Autonomic Security.

REFERENCE BOOKS:

1. George Coulouris, Jean Dellimore and Tim KIndberg, "Distributed Systems Concepts and Design", Pearson Education, 4th Edition, 2005
2. Sunita Mahajan, Seema Shah , "Distributed Computing", OXFORD University Press, 2013
3. Joshy Joseph,Craig Fellenstein, "Grid Computing", IBM Press, Pearson Education, 2004.
4. Ahmar Abbas, "Grid Computing: A Practical Guide to Technology and Applications, Firewall Media", 2009.
5. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, "Cloud Computing –A Practical Approach", Tata McGraw Hill Education Pvt. Ltd, 2010.
6. Gautam Shroff , Enterprise Cloud Computing"", Cambridge University Press, 2010.

PAPER III – 11.ARTIFICIAL INTELLIGENCE AND ROBOTICS

Unit I

Introduction: What is AI, Intelligent agents : Introduction: How Agents Should Act, The ideal mapping from percept sequences to actions, Autonomy, Structure of Intelligent Agents, Agent programs, An example, Simple reflex agents, Agents that keep track of the world, Goal-based agents, Utility-based agents, Environments, Properties of environments, Environment programs.
Problem solving: Solving Problems by Searching, Informed Search Methods.

Unit II

Knowledge and reasoning :Agents that Reason Logically: A Knowledge-Based Agent, The Wumpus World Environment, Specifying the environment, Acting and reasoning in the Wumpus world, Representation Reasoning, and Logic: Representation, Inference, Logics, Prepositional Logic: A Very Simple Logic: Syntax, Semantics, Validity and inference, Models, Rules of inference for propositional logic. First-Order Logic, Building a Knowledge Base.

Unit III

Knowledge and reasoning: Inference in First-Order Logic: Inference Rules Involving Quantifiers, An Example Proof, Generalized Modus Ponens, Forward and Backward Chaining, Completeness, Resolution: Completeness of resolution
A Logical Reasoning System, Uncertain knowledge and reasoning: Uncertainty, Probabilistic Reasoning Systems.

Unit IV

Introduction : Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots
Robot Kinematics And Dynamics: Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations - Transformation Arithmetic - D-H Representation - Forward and inverse Kinematics Of Six Degree of Freedom Robot Arm – Robot Arm dynamics.

Unit V

Robot Drives And Power Transmission Systems: Robot drive mechanisms, hydraulic – electric – servomotor- stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws.

Manipulators: Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic manipulators.

Robot End Effectors: Classification of End effectors – Tools as end effectors. Drive system for grippers-Mechanical-adhesive vacuum-magnetic-grippers. Hooks & scoops. Gripper force analysis and gripper design. Active and passive grippers.

REFERENCE BOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Ed., Prentice Hall, 2009.
2. David Poole, Alan Mackworth, Artificial Intelligence: Foundations for Computational Agents, Cambridge Univ. Press, 2010.
3. Ronald Brachman, Knowledge Representation and Reasoning, Morgan Kaufmann, 2004
4. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Chapman and Hall, 2009.
5. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, McGraw-Hill Education., 2009
6. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012
7. Francis N. Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987, Digitized 2007.
8. S. R. Deb and S. Deb, ‘Robotics Technology and Flexible Automation’, Tata McGraw Hill Education Pvt. Ltd, 2010.
9. John J.Craig , ‘Introduction to Robotics’, Pearson, 2009.

PAPER III – 12. BIOINSPIRED COMPUTING

UNIT - I Natural to Artificial Systems – Biological Inspirations in problem solving – Behavior of Social Insects: Foraging - Division of Labor - Task Allocation– Cemetery Organization and Brood Sorting – Nest Building- Cooperative transport.

UNIT - II Ant Colony Optimization [ACO]: Ant Behavior - Towards Artificial Ants - Combinatorial Optimization - Ant Colony Optimization Metaheuristic – Problem solving using ACO-Extensions of Ant Systems – ACO and Local search methods - ACO theoretical considerations and Convergence.

UNIT - III Ant Colony Optimization algorithms for NP-hard problems- Routing problems- Assignment problems - Scheduling problems – Subset problems - Machine Learning Problems – ACO for Travelling Salesman problem.

UNIT - IV Swarm Intelligence: Biological foundations of Swarm Intelligence – Swarm Intelligence in Optimization – Particle Swarms for dynamic optimization problems.

UNIT - V Biological Inspired computing to Natural Computing – Integration of Evolutionary Computation Components in Ant Colony Optimization – Particle Swarm Optimization based on Socio-cognition.

REFERENCE BOOKS:

1. Marco Dorigo, Thomas Stutzle, “Ant Colony Optimization”, MIT Press, 2004.
2. Eric Bonabeau, Marco Dorigo, Guy Theraulaz, ”Swarm Intelligence: From Natural to ArtificialSystems”, Oxford University press, 2000.
3. Christian Blum, Daniel Merkle (Eds.),”Swarm Intelligence: Introduction and Applications”,Springer Verlag, 2008.
4. Leandro N De Castro, Fernando J Von Zuben,” Recent Developments in Biologically Inspired Computing”, Idea Group Inc., 2005.

PAPER III – 13. CONCURRENT ENGINEERING INFORMATION SYSTEM

UNIT - I New Product Development And Management : Designing and Developing Products More Effectively - Complexity and Centrality - The Value of Operational Perspectives; Structuring the Work: Phases, Gates, and Simultaneous Engineering - Description of the NPI Process - Gate Reviews - The Practice of Simultaneous Engineering - Managing the Phase - Gate Process; Planning and Managing the Projects - The Need for Multiple Targets - Setting the Target Levels under Different Situations - Interactions among the Targets - Managing NPI Projects to Meet Cycle Time Targets - The Role of the Project Manager.

UNIT - II Concurrent Engineering And Information Modeling : Concurrent Engineering: Basic Principles of CE - Components of CE - Concurrency and Simultaneity - Modes of Concurrency - Modes of Cooperation - Benefits of Concurrent Engineering; Information Modeling: Introduction - Information Modeling - Modeling Methodology - Foundation of Information Modeling - Concurrent Engineering Process Invariant - Enterprise Model-Class - Specification Model-Class - Product Model-Class - Process Model- Class - Cognitive Models - Merits and Demerits.

UNIT - III Concurrent Engineering Information System And Process Modeling: Design For Quality, and for Other Objective Functions (DFx); Concurrent Engineering Methods and Tools; Concurrent Engineering Information System and Process Modeling - Concurrent Engineering, Advanced Integrated Product / Process Design Methods, as Part of Collaborative Design in PLM; Integration of Concurrent Engineering and Quality, Collaborative, Networked TQM.

UNIT - IV Software Tools For Concurrent Engineering: Concurrent Engineering Customer Requirements Analysis Modeling, Based on the QFD (Quality Function Deployment) Method, Using CORA (Component Oriented Requirements Analysis) Software Tool for PLM; Concurrent Engineering Process Failure Risk Analysis Modeling (PFRA); a Failure Mode and Effect Analysis (FMEA) Method, and Software Tool.

UNIT - V Case Studies : Collaboration of Parametric Technology's a Failure Mode and Effect Analysis (FMEA) Method; ProEngineer Wildfire and Windchill Software Tools - Rapid Prototyping Methods, Tools - Kaizen, Kanban, JIT (Just-in-Time), and Lean Production Control Methods to Support the Integrated Design Processes and Flexible / Real-time Dynamic Supply Chains in PLM - The Lean Six Sigma Methodology - Continuous Design Improvement Methods.

REFERENCE BOOKS:

1. Stephen R. Rosenthal, “Effective product design and development: how to cut lead time and
   increase customer satisfaction”, Business One, Illinois [Unit 1].
2. Biren Prasad, “Concurrent Engineering Fundamentals: Integrated Product and Process Organization” Volume I, Prentice Hall, 1995 [Unit 2].
3. Paul G Ranky, Richard G Ranky, “Concurrent / Simultaneous Engineering Methods, Tools and Case Studies Within a Quality Green PLM, (Product Lifecycle Management) Framework”, CIMware USA, 1872631045, ISBN-13: 978-1872631042, http://www.cimwareukandusa.com/CIMwMedia/IntroCE-PLM-eBook-Wobject.html [Units 3, 4, 5].

4. Bin Wu, "Manufacturing systems design and analysis: context and techniques", Chapman Hall, London, 2000.
5. Andrew Kusiak, "Concurrent Engineering: Automation, Tools, and Techniques, Wiley-Interscience", 1992, ISBN-10: 0471554928, ISBN-13: 978-0471554929 .

PAPER III – 14. SPEECH PROCESSING

UNIT - I Introduction to speech processing – History – Applications- Speech production: Mechanism of speech production- Acoustic phonetics – Digital models for speech signals – Speech waveform representations- Sampling speech signals- Basics of quantization.

UNIT - II Short-time analysis of speech- Short-time energy and Zero crossing rate-Short-time auto correlation method – Short-time Fourier Transform –Speech spectrogram- Homomorphic speech analysis-Cepstrum and Complex Cepstrum-The short-time cepstrum-Computation of Cepstrum - Mel Frequency Cepstrum Co-efficients - Linear predictive analysis.

UNIT - III Text to Speech Synthesis: Basic principles - Rule based speech synthesis - Corpus based peech synthesis -Linguistic processing - Prosodic processing

UNIT - IV Speech Recognition: Speech recognition architecture- Types of speech recognition-Issues in speech recognition-Speech databases-Performance evaluation of SR systems-Applications - Feature extraction methods- Speech recognition methodologies: Acoustic-phonetic approach-Pattern recognition approach: Template based approach-Dynamic Time Warping-Hidden Markov Model-Vector Quantization – Support Vector Machine - Neural network based approaches.Language Model- Trigram language model –CMU SLM Toolkit.

UNIT - V Speaker Identification and Verification: Measuring speaker features- Statistical Vs Dynamic features - Cepstral analysis – Similarity Vs Distance measures - Constructing speaker models – Adaptation - Applications of speaker recognition - Text dependent speaker recognition - Text independent speaker recognition- Generative approaches: Rationale - Gaussian mixture model (GMM)- Neural network approaches - Discriminative approaches: Support Vector Machine(SVM) - Kernels.

REFERENCE BOOKS:

1. L. R. Rabiner, R. W. Schaffer, "Digital Processing of Speech signals", Prentice Hall, 1978.
2. Jacob Benesty, M. Mohan Sondhi, Yiteng Huang "Springer handbook of speech Processing",Springer, 2007.
3. Douglas O,Shaughnessy, " Speech Communications: Human and Machine", Wiley- IEEE Press, 1999.
4. L.R.Rabiner, B.H.Juang, " Fundamentals of speech recognition", Prentice Hall, 1993.

PAPER III – 15.INFORMATION SECURITY

UNIT – I

Conventional Encryption : Classical Technique – Modern technique – Algorithms.
Public Key Cryptography : Public Key Cryptography – Introduction to Number Theory – Message Authentication and Hash Function – HASH and MAC Algorithm – Digital Signature and Authentication protocol.

UNIT - II

Network Security Practice : Authentication Application – Electronic Mail Security – IP Security
Program Security and System Security: Secure programs – Nonmalicious program errors – viruses and Worms – Memory and address protection – control access to general objects – File protection mechanism – user authentication – Trusted operating system design and assurance – Intrusion Detection system.

UNIT - III

System Security and Web Security : Intruders,– Firewall - Managing Access – Password management - Web Security requirements – SSL and TLS – SET -Client Side Security : Using SSL – Active Content – Web Privacy.

UNIT - IV

Database Security :
The Database as a Networked Server – Securing database-to-database communication – Reliability and Integrity of database – sensitive data – inference – multilevel databases.

UNIT V

Digital Watermarking and Steganography :
Models of Watermarking – Basic Message Coding – Watermark Security – Content Authentication – Steganography
Cloud Security : Security Design and Architecture for Cloud Computing - Secure Isolation of Physical & Logical Infrastructure - Data Protection for Cloud Infrastructure and Services - Enforcing Access Control for Cloud Infrastructure based Services

REFERENCE BOOKS:

1. Charrles P. Pfleeger and– Shari Lawrence Pfleegner, “Security in Computing”, Prentice Hall of India, 2007.
2. William Stallings, “Cryptography and Network Security”, Pearson 5th Edition
3. John W.Rittinghouse and James F.Ransome, “Wireless Operaional Security”, Elsevier, 2004
4. Ron Ben Natan,Implementing Database Securityand Auditing”, Elsevier, 2005.
5. Lincoln D. Stein, “ Web Security”, Addison Wesley, 1999.
6. Ingemar J.Cox, Matthew L. Miller Jeffrey A.Bloom, Jessica Fridrich and Ton Kalker, : Digital Watermarking and Steganography, Elsevier, Second Edition.
7. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler Syngress Elsevier
8. Cloud Computing Design Patterns by Thomas Erl,Prentice Hall.