RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

AL-501Operating Systems

COURSE OBJECTIVES:

To makestudentsunderstand the importance and overall functioning of an Operating System; To acquaint the students with the concepts and principles that underlie the modern Operating Systems, and to provide them an insight in the working of its various modules.

COURSE OUTCOMES:

After completing the course, student should be able to:

1. Get clear understanding about the need and objectives of an Operating System and various services provided by the Operating Systems.
2. Gain a detailed knowledge about the functions of different modules of an Operating System, viz. process management, file system management, memory management, device management etc.
3. Visualize the internal implementation of various modules of Operating System and correlate the same with the actual implementation of these modules in Unix/Linux and other contemporary Operating Systems.
4. Acquire the ability to design and implement small modules of Operating System, Shell and Commands, using system calls of Unix/Linux or some educational Operating System.

COURSE CONTENTS:

UNIT1: **Introduction to Operating Systems**: Function, Evolution, Different types of Operating Systems, Desirable Characteristics and features of an O/S.
Operating Systems Services: Types of Services, Different ways of providing these Services– Commands, System Calls.Need of System Calls, Low level implementation of System Calls, Portability issue, Operating System Structures.

UNIT II: File Systems (Secondary Storage Management): File Concept, User's and System Programmer's view of File System, Hard Disk Organization, Disk Formatting and File System Creation, Different Modules of a File System, Disk Space Allocation Methods – Contiguous, Linked, Indexed. Disk Partitioning andMounting; Directory Structures, File Protection; Virtual and Remote File Systems. Case Studies of File Systems being used in Unix/Linux & Windows; System Calls used in these Operating Systems for file management.

UNITIII: Process Management: Concept of a process, Process State Diagram, Different type of schedulers, CPU scheduling algorithms, Evaluation of scheduling algorithms, Concept of Threads: User level & Kernel level Threads, Thread Scheduling;Multiprocessor/Multicore Processor Scheduling.Case Studies of Process Management in Unix/Linux& Windows; System Calls used in these Operating Systems for

Process Management.
Concurrency& Synchronization: Real and Virtual Concurrency, Mutual Exclusion, Synchronization, Critical Section Problem, Solution to Critical Section Problem: Mutex Locks; Monitors; Semaphores,WAIT/SIGNAL operations and their implementation;Classical Problems of Synchronization;Inter-Process Communication.
Deadlocks: Deadlock Characterization, Prevention, Avoidance, Recovery.

UNIT IV: **Memory Management**: Different Memory Management Techniques –Contiguous allocation; Non-contiguous allocation: Paging, Segmentation, Paged Segmentation; Comparison of these techniques.
Virtual Memory – Concept, Overlay, Dynamic Linking and Loading, Implementation of Virtual Memory by Demand Paging etc.; Memory Management in Unix/Linux& Windows.

UNIT V: Input/Output Management: Overview of Mass Storage Structures, Disk Scheduling;I/O Systems: Different I/O Operations- Program Controlled, Interrupt Driven, Concurrent I/O, Synchronous/Asynchronous and Blocking/Non-Blocking I/O Operations, I/O Buffering,Application I/O Interface, Kernel I/O Subsystem, Transforming I/O requests to hardware operations.

Overview of Protection & Security Issues and Mechanisms; Introduction to Multiprocessor, Real Time, Embedded and Mobile Operating Systems; Overview of Virtualization.

TEXTBOOKSRECOMMENDED:

1. Silberschatz, Galvin, Gagne, “Operating System Concepts’’,John Wiley& Sons.
2. William Stalling, “Operating Systems: Internals and Design Principles”, Pearson.

REFERENCEBOOKS:

1. Andrew S. Tanenbaum, “Modern Operating Systems”, Prentice Hall.
2. Robert Love, “Linux Kernel Development”, Pearson.
3. Maurice J. Bach, “The Design of Unix Operating System”, Pearson.
4. Bovet &Cesati, “Understanding the Linux Kernel”, O'Reilly.

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

AL-502 Database Management Systems

COURSE OBJECTIVES: The objective of this course is to enable students in developing a high level understanding of the concepts of Database management systems in contrast with traditional data management systems with emphasis on skills to apply these concepts in building, maintaining and retrieving data from these DBMS.

COURSE OUTCOMES:

After completing the course student should be able to:

1. Describe design of a database at various levels and compare andcontrast traditional data processing with DBMS.
2. Design a database using Entity Relationship diagram and other design techniques.
3. Apply fundamentals of relational model to model and implement a sample Database Management System for a given domain.
4. Evaluate and optimize queries and apply concepts of transaction management.

COURSE CONTENTS:

UNIT I:DBMS Concepts and architecture Introduction, Database approach v/s Traditional file accessing approach, Advantages of database systems, Data models, Schemas and instances, Data independence, Data Base Language and interfaces, Overall Database Structure, Functions of DBA and designer, ER data model: Entitles and attributes, Entity types, Defining the E-R diagram, Concept of Generalization, Aggregation and Specialization. Transforming ER diagram into the tables. Various other data models object oriented data Model, Network data model, and Relational data model, Comparison between the three typesof models.Storage structures: Secondary Storage Devices, Hashing & Indexing structures: Single level & multilevel indices.

UNIT II: Relational Data models: Domains, Tuples, Attributes, Relations, Characteristics of relations, Keys, Key attributes of relation, Relational database, Schemas, Integrity constraints. Referential integrity, Intension and Extension, Relational Query languages: SQL-DDL, DML, integrity con straints, Complex queries, various joins, indexing, triggers, assertions , Relational algebra and relational calculus, Relational algebra operations like select, Project ,Join, Division, outer union. Types of relational calculus i.e. Tuple oriented and domain oriented relational calculus and its operations.

UNIT III: Data Base Design: Introduction to normalization, Normal forms- 1NF, 2NF, 3NF

and BCNF, Functional dependency,Decomposition, Dependency preservation and lossless join, problems with null valued and dangling tuples, multivalued dependencies. Query Optimization: Introduction, steps of optimization, various algorithms to implement select, project and join operations of relational algebra, optimization methods: heuristic based, cost estimation based.

UNIT IV: Transaction Processing Concepts: -Transaction System, Testing of Serializability, Serializability of schedules, conflict & view serializable schedule, recoverability, Recoveryfrom transaction failures. Log based recovery. Checkpoints deadlock handling. Concurrency Control Techniques: Concurrency Control, locking Techniques for concurrency control, timestamping protocols for concurrency control, validation based protocol, multiple granularity.Multi version schemes, Recovery with concurrent transaction. Introduction to Distributeddatabases, data mining, data warehousing, Object Technology and DBMS, Comparativestudy of OODBMS Vs DBMS . Temporal, Deductive, Multimedia, Web & Mobile database.

UNIT V: Case Study of Relational Database Management Systems through Oracle/PostgreSQL /MySQL: Architecture, physical files, memory structures, background process. Data dictionary, dynamic performance view. Security, role management, privilege management, profiles, invoker defined security model. SQL queries, Hierarchical quires, inline queries, flashback queries. Introduction of ANSI SQL, Cursor management: nested and parameterized cursors. Stored procedures, usage of parameters in procedures. User defined functions their limitations. Triggers, mutating errors, instead of triggers.

TEXT BOOKS RECOMMENDED:

1. Korth H.F. &Silberschatz A., Sudarshan, “Database Systems”, McGraw-Hill
2. Chris J. Date, with Hugh Darwin, Addison-Wesley, “A Guide to SQL Standard”.
3. Elmasri R., Navathe S.B., “Fundamentals of Database Systems”, Pearson.

REFERENCE BOOKS:

1. Rob, “ Database System:Design Implementation& Management”, Cengage Learning.
2. AtulKahate , “Introduction to Database Management System”, Pearson Educations
3. Oracle 9i Database Administration Fundamental-I, Volume I, Oracle Press,TMH.
4. Paneerselvam,”Database Management System”, PHI Learning

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

Departmental Elective AL503 (A) Information Retrieval

UNIT-I: Introduction - History of IR- Components of IR - Issues -Open source Search engine Frameworks - The Impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a search engine, Characterizing the web.

UNIT –II: Boolean and Vector space retrieval models- Term weighting - TF-IDF weighting-cosinesimilarity - Preprocessing - Inverted indices - efficient processing with sparse vectors LanguageModel based IR - Probabilistic IR -Latent Semantic indexing - Relevance feedback and queryexpansion.

UNIT- III: Web search overview, web structure the user paid placement search engine optimization, WebSearch Architectures - crawling - meta-crawlers, Focused Crawling - web indexes - Nearduplicate detection - Index Compression - XML retrieval.

UNIT –IV: Link Analysis -hubs and authorities - Page Rank and HITS algorithms -Searching and Ranking -Relevance Scoring and ranking for Web - Similarity - Hadoop & Map Reduce - Evaluation -Personalized search - Collaborative filtering and content-based recommendation of documentsAnd products - handling invisible Web - Snippet generation, Summarization. Question
Answering, Cross-Lingual Retrieval.

UNIT –V: Information filtering: organization and relevance feedback - Text Mining- Text classification andclustering - Categorization algorithms, naive Bayes, decision trees and nearest neighbor -Clustering algorithms: agglomerative clustering, k-means, expectation maximization (EM).

References:

1. C. Manning, P. Raghvan and H Schutze: Introduction to Information Retrieval, Cambridge University Press.
2. Ricardo Baeza Yates and Berthier Ribeiro Neto, Modern Information Retrieval :The Concepts and Technology behind Search, ACM Press Books.
3. Bruce Croft, Donald Metzler and Trevor Strohman,Search Engines Information Retrieval in Practice, Addison Wesley.
4.Mark Levene, An Introduction to Search Engines and Web Navigation, Wiley.

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New Scheme Based On AICTE Flexible Curricula

CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

Departmental Elective AL 503 (B) Deep Learning

COURSE OBJECTIVES: Introduce deep learning fundamentals and major algorithms, the problem settings, and their applications to solve real world problems.

COURSE OUTCOMES:

After completing the course student should be able to:

1. Describe in-depth about theories, fundamentals, and techniques in Deep learning.
2. Identify the on-going research in computer vision and multimedia field.
3. Evaluate various deep networks using performance parameters.
4. Design and validate deep neural network as per requirements.

Unit I: Introduction History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptions (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation, weight initialization methods, Batch Normalization, Representation Learning, GPU implementation, Decomposition – PCA and SVD.

Unit II: Deep Feedforward Neural Networks, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, Adam, RMSProp, Auto-encoder, Regularization in auto-encoders, Denoising auto-encoders, Sparse auto-encoders, Contractive auto-encoders,Variational auto-encoder, Auto-encoders relationship with PCA and SVD, Dataset augmentation.Denoising auto encoders,

Unit III: Introduction to Convolutional neural Networks (CNN) and its architectures, CCN terminologies: ReLu activation function, Stride, padding, pooling, convolutions operations, Convolutional kernels, types of layers: Convolutional, pooling, fully connected, Visualizing CNN, CNN examples: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, RCNNetc. Deep Dream, Deep Art. Regularization: Dropout, drop Connect, unit pruning, stochastic pooling, artificial data, injecting noise in input, early stopping, Limit Number of parameters, Weight decay etc.

Unit IV: Introduction to Deep Recurrent Neural Networks and its architectures, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Gated Recurrent Units (GRUs), Long Short Term Memory (LSTM), Solving the vanishing gradient problem with LSTMs, Encoding and decoding in RNN network, Attention Mechanism, Attention over images, Hierarchical Attention, Directed Graphical Models. Applications of Deep RNN in Image Processing, Natural Language Processing, Speech recognition, Video Analytics.

Unit V: Introduction to Deep Generative Models, Restricted Boltzmann Machines (RBMs), Gibbs Sampling for training RBMs, Deep belief networks, Markov Networks, Markov Chains, Auto-regressive Models: NADE, MADE, PixelRNN, Generative Adversarial Networks (GANs), Applications of Deep Learning in Object detection, speech/ image recognition, video analysis, NLP, medical science etc.

TEXT BOOKS RECOMMENDED:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville; Deep Learning, MIT Press.
2. Charu C. Aggarwal "Neural Networks and Deep Learning: A Textbook", Springer.
3. Francois Chollet, "Deep Learning with Python", Manning Publications.

REFERENCE BOOKS:

1. Aurelien Geon, “Hands-On Machine Learning with Scikit-Learn and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems”, O'Reilly.
2. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly.
3. Adam Gibson, Josh Patterson, "Deep Learning: A Practitioner's Approach", O'Reilly.

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

Departmental Elective AL503(C) Optimization Techniques in Machine Leaning

Course Objective: The students will be able to understand and analyze how to deal with changing data. They will also be able to identify and interpret potential unintended effects in your project. They will understand and define procedures to operationalize and maintain your applied machine learning model.Detailed Contents:

Unit I: Introduction What is optimization, Formulation of LPP, Solution of LPP: Simplex method, Basic Calculus for optimization: Limits and multivariate functions, Derivatives and linear approximations: Singlevariate functions and multivariate functions.

Unit II: Machine Learning Strategy ML readiness, Risk mitigation, Experimental mindset, Build/buy/partner, setting up a team, Understanding and communicating change.

Unit III: Responsible Machine Learning AI for good and all, Positive feedback loops and negative feedback loops, Metric design and observing behaviours, Secondary effects of optimization, Regulatoryconcerns.

Unit IV: Machine Learning in production and planning Integrating info systems, users break things, time and space complexity in production, when to retain the model? Logging ML model versioning, Knowledge transfer, Reporting performance to stakeholders.

Unit V: Care and feeding of your machine learning model MLPL Recap, Post deployment challenges, QUAM monitoring and logging, QUAM Testing, QUAM maintenance, QUAM updating, Separating Datastack from Production, Dashboard Essentials and Metrics monitoring.

Books/Suggested References:

1. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020.
2. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021
3. Optimization for Machine Learning, SuvritSra, Sebastian Nowozin and Stephen J. Wright, MITPress, 2011.
4. Optimization in Machine Learning and Applications, Suresh Chandra Satapathy, Anand J. Kulkarni,Springer, 2019

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

Open Elective AL504 (A) AI in Health Care

Course Objective: The students should be able to understand how AI is transforming the practice of medicine. The students should learn the practical experience in applying machine learning to concrete problems in medicine. Detailed contents:

Unit I: Disease detection with computer vision Medical Image Diagnosis, Eye Disease and Cancer Diagnosis, Building and Training a Model for Medical Diagnosis, Training, prediction, and loss, ImageClassification and Class Imbalance, Generating More Samples, Model Testing

Unit II: Evaluating models Sensitivity, Specificity, and Evaluation Metrics, Accuracy in terms of conditional probability, Confusion matrix, ROC curve and Threshold Image segmentation on MRI images Medical Image Segmentation, MRI Data and Image Registration, Segmentation, 2D U-Net and 3D U-Net Data augmentation and loss function for segmentation, Different Populations and DiagnosticTechnology, External validation.

Unit III: Linear prognostic models Medical Prognosis, Atrial fibrillation, Liver Disease Mortality, Risk of heart disease, Evaluating Prognostic Models, Concordant Pairs, Risk Ties, Permissible Pairs. Prognosis with Tree-based models Decision trees for prognosis, fix overfitting, Different distributions,Missing Data example, Imputation.

Unit IV: Survival Models and Time Survival Model, Survival function, collecting time data, estimating the survival function. Build a risk model using linear and tree-based models Hazard Functions, Relativerisk, Individual vs. baseline hazard, Survival Trees, Nelson Aalen estimator.

Unit V: Medical Treatment Effect Estimation Analyze data from a randomized control trial, Average treatment effect, Conditional average treatment effect, T-Learner, S-Learner, C-for-benefit.

Text Books/Suggested References:

1. https://www.coursera.org/learn/ai-for-medical-diagnosis
2.https://www.coursera.org/learn/ai-for-medical-prognosis#syllabus
3. https://www.coursera.org/learn/ai-for-medical-treatment#syllabus
4. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Eric Topol, BasicBooks, 1st edition 2019.
5. Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, Arjun Panesar, Apress, 1st ed. Edition, 2019. 6. Artificial Intelligence in Healthcare, 2020, ISBN 978-0-12-818438-7,Elsevier Inc

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

Open Elective AL 504 (B) Natural Language Processing

COURSE OBJECTIVES: Students should develop a basic understanding in natural language processing methods and strategies and to evaluate the strengths and weaknesses of various Natural Language Processing (NLP) methods & technologies and gain an insight into the application areas of Natural language processing.

COURSE OUTCOMES:

After completing the course student should be able to:

1. Define different data models used in Information Retrieval using NLP.
2. Demonstrate current methods for statistical approaches to machine translation.
3. Apply syntactic parsing and semantic analysis on text.
4. Solve and implement real world problems using NLP.

Detailed Contents:

UNIT I:Introduction: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II:Word Level Analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models,Viterbi algorithms and EM training.

UNIT III:Syntactic Analysis: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

UNIT IV:Semantics and Pragmatics: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.Compositional semantics.

UNIT V:Application of NLP: intelligent work processors: Machine translation, user interfaces,Man-Machine interfaces, natural language querying, tutoring and authoring systems, speechrecognition, and commercial use of NLP.

Text Books:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, OReilly Media.
3. Manning and Schutze "Foundations of Statistical Natural Language Processing", MIT Press.

Reference Books:

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher.
2. Richard M Reese, Natural Language Processing with Java, OReilly Media.
3. Nitin Indurkhya and Fred J. Damerau, Handbook of Natural Language Processing, Chapman and Hall/CRC Press.
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press.

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CSE-Artificial Intelligence and Machine Learning/ Artificial Intelligence and Machine Learning, V-Semester

Open Elective AL 504 (C) Computational Intelligence

COURSE OBJECTIVES:

1. To introduce basic concepts, theories and techniques of computational intelligence.
2. Help students to learn the applications of computational intelligence techniques in the diverse fields of science, engineering, medicine, finance etc.

COURSE OUTCOMES:

After completing the course student should be able to:

1. Describe in-depth about theories, methods, and algorithms in computational Intelligence.
2. Compare and contrast traditional algorithms with nature inspired algorithms.
3. Examine the nature of a problem at hand and determine whether a computational intelligent technique/algorithm can solve it efficiently enough.
4. Design and implement Computation Intelligence algorithms and approaches for solving real-life problems.

Unit1: Introduction to Computational Intelligence (CI): Basics of CI, History of CI, Adaptation, Learning, Self-Organization, State Space Search and Evolution, CI and Soft Computing, CI Techniques; Applications of CI; Decision Trees: Introduction, Evaluation, Different splitting criterion, Implementation aspect of decision tree. Neural Network: Introduction, types, issues, implementation, applications.

Unit II: Fuzzy Set Theory: Fuzzy Sets, Fuzzy Set Characteristics, Basic Definition and Terminology, Fuzzy Operators,Fuzzy Relations and Composition, Member Function Formulation, Fuzzy Rules and Fuzzy Reasoning, Extension, Fuzzy Inference Systems, Input Space Partitioning and Fuzzy Modeling. Fuzziness and Defuzzification, Fuzzy Controllers, Different Fuzzy Models: Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models etc. Neuro Fuzzy Modeling, Introduction to Neuro Fuzzy Control.

Unit III: Rough Set Theory: Introduction, Fundamental Concepts, Knowledge Representation, Set Approximations and Accuracy, Vagueness and Uncertainty in Rough Sets, Rough Membership Function, Attributes Dependency and Reduction, Application Domain, Hidden Markov Model (HMM), Graphical Models, Variable Elimination, Belief Propagation, Markov Decision Processes.

Unit IV: Evolutionary Computation: Genetic Algorithms: Basic Genetics, Concepts, Working Principle, Creation of Offsprings, Encoding, Fitness Function, Selection Functions, Genetic Operators-Reproduction, Crossover, Mutation; Genetic Modeling, Benefits; Problem Solving; Introduction to Genetic Programming, Evolutionary Programming, and Evolutionary Strategies.

Unit V: Swarm Intelligence: Introduction to Swarm Intelligence, Swarm Intelligence Techniques: Ant Colony Optimization (ACO): Overview, ACO Algorithm; Particle Swarm Optimization (PSO): Basics, Social Network Structures, PSO Parameters and Algorithm; Grey wolf optimization(GWO); Application Domain of ACO and PSO; Bee Colony Optimization etc.; Hybrid CI Techniques and applications; CI Tools.

Reference Books:

1. Russell C. Eberhart and Yuhui Shi, Computational Intelligence: Concepts to Implementations, Morgan Kaufmann Publishers.
2. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley Publishing.
3. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning, Pearson Education.
4. Jagdish Chand Bansal, Pramod Kumar Singh, Nikhil R. Pal, Evolutionary and Swarm Intelligence Algorithms, Springer Publishing.
5. S. Rajasekaran, G.A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic, Genetic Algorithms Synthesis and Applications", PHI.
6. Fuzzy Logic with Engineering Applications, Timothy J. Ross,McGraw-Hill.
7. NeuralNetworks: A Comprehensive Foundation, SimonHaykin, Prentice Hall