Solapur University Solapur

Syllabus for Ph.D. Course work in

Computer Science

(With effect from June 2014)

Paper No.	Paper title	Marks (Theory examination)
I	Research methodology and information communication technology (ICT)	100
II	Modern topics in Computer Science	100
III	Advanced topics in Computer Science Elective – I: Digital Image Processing Elective – II: Data Warehousing and Mining Elective – III: Artificial Intelligence	100
Total		**300**

Paper II: Modern topics in Computer Science

Unit 1
Basics of artificial neural networks: Characteristics of neural networks, ANN terminology, Models of neuron, topology, Basic learning laws, Activation and synoptic dynamics: Activation dynamic models, Synaptic dynamic models, Learning methods, Introduction to feedforward and feedback neural networks.

Unit 2
Crisp sets, Fuzzy sets, Fuzzy sets versus Crisp sets: additional properties of α (alpha) – cuts, Representation of Fuzzy sets, Operations on Fuzzy sets: types of operations, Fuzzy complements, Fuzzy intersections – t norms, Fuzzy unions – t conorms, Fuzzy systems: Fuzzy controllers – overview and examples, Fuzzy systems and neural networks, Fuzzy neural networks.

Unit 3
Computer Graphics: Points and lines, Line drawing algorithms, circle generating algorithms, other curves, two-dimensional geometric transformations: Basic transformations, matrix representation and homogeneous coordinates, composite transformations, other transformations, transformation between coordinate systems, Affine transformation.

Unit 4
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 5
Distributed Computing: Distributed Systems: Fully distributed processing systems – Networks and Interconnection structures – Designing a distributed processing system – Distributed databases- challenge of distributed data – loading factors – managing the distributed resources – division of responsibilities.

Unit 6
Client/Server Technology: Client/Server Computing-What is Client/Server-Types of Servers-SQL Database server-The fundamentals of SQL and relational databases - What does a database server do-Stored Procedures, Triggers and rules- SQL Middleware and federated databases-SQL middleware-Will the real SQL API Please stand up? Open SQL gateways-data warehouses-Distributed Objects and components-From Distributed Objects to components-3Tier Client Server, Object Style-CORBA-

Distributed Objects, CORBA style-OMG's object management architecture-CORBA 2.0-CORBA.Object Services-CORBA common facilities –CORBA business objects.

Reference books
1. Artificial Neural Networks: B, Yagnanarayana, Prentice Hall of India, 2006.
2. Neural Networks: James A. Freeman and David M. Skapura, Pearson Edition.
3. Fuzzy sets and Fuzzy logic: George J. Klir and Bo Yuan, Prentice Hall of India, 2009.
4. Fuzzy logic: Timothy J. Ross, John Wiley & Sons Ltd, 2004.
5. Computer Graphics: Donald Hearn and M. Pauline Baker, Prentice Hall of India, 1994.
6. Computer Graphics: James D. Foley, Addison Wesley, 1995.
7. Data structures and Algorithms: Alfre V. Aho, John E. Hcpcroft and Jeffrey D. Ullman, Addison- Wesley Publishing Company, 1987.
8. Compute Algorithms: Ellis Harowitz and Sartaj Sahini, Galgotia Publications (P) Ltd., 1993.
9. An Introduction to Distributed and Parallel Processing: John A. Sharp, Blackwell Scientific Publications, 1987.
10. Data Communications & Distributed Networks: Uyless D. Black, Prentice Hall, 1997.
11. Introduction to Distributed & Parallel Computing: Joel M. Crichllow, Prentice Hall, 1988.
12. Distributed Databases Principles and systems: Stefans Ceri, Ginseppe Pelagatti, McGraw Hill Book Co., New York, 1985.
13. The Essential Client/Server Survival Guide: Robert Orfali, Dan Harkey, Jerry and Edwards, Galgotia Publications.

Paper III: Advanced topics in Computer Science
Elective – I: Digital Image Processing

Unit 1

Introduction: Definition of Digital Image Processing, The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Unit 2

3 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, Combining Spatial Enhancement Methods.

Image Enhancement in the Frequency: Introduction to the Fourier Transform and the Frequency Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering, Implementation

Unit 3

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, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Geometric Transformations.

Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing, Color Transformations.

Unit 4

Wavelets and Multiresolution Processing: Background, Multiresolution Expansions, Wavelet Transforms in One Dimension, Wavelet Transforms in Two Dimensions, Wavelet Packets.

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory, Error-Free Compression, Lossy Compression.

Unit 5

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

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation, Segmentation by Morphological Watersheds, The Use of Motion in Segmentation.

Unit 6
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. Digital Image Processing: Rafael C. Gonzalez, Richard C. Woods (Prentice Hall India).
2. Image Processing, Analysis and Machine Vision: Milan Sonka, Vaclav Hlavac, Roger Boyle (Thomson Brooks / Cole Edition).
3. Fundamentals of Digital Image Processing: Anil K. Jain (Prentice Hall India).

Paper III: Advanced topics in Computer Science
Elective – II: Data warehousing and mining

Unit 1
Introduction: Meaning, importance and motivation for data mining, Data Mining—On Kind of Data, Data Mining Functionalities, Interesting patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or DataWarehouse System, Major Issues in Data Mining.
Data Preprocessing: Data preprocessing, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

Unit 2
DataWarehouse and OLAP Technology: An Overview, DataWarehouse definition, A Multidimensional Data Model, DataWarehouse Architecture, DataWarehouse Implementation, From DataWarehousing to Data Mining.
Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction—An Alternative Method for Data Generalization and Concept Description.

Unit 3
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and a Road Map, Efficient and Scalable Frequent Itemset Mining Methods, Mining Various Kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining.
Classification and Prediction: What Is Classification? What Is Prediction? Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation, Support Vector Machines, Associative Classification: Classification by Association
Rule Analysis, Lazy Learners (or Learning from Your Neighbors), Other Classification Methods, Prediction, Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor, Ensemble Methods—Increasing the Accuracy, Model Selection.

Unit 4
Cluster Analysis: What Is Cluster Analysis? Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.
Mining Stream, Time-Series, and Sequence Data: Mining Data Streams, Mining Time-Series Data, Mining Sequence Patterns in Transactional Databases, Mining Sequence Patterns in Biological Data.

Unit 5

Graph Mining, Social Network Analysis, and Multirelational Data Mining: Graph Mining, Social Network Analysis, Multirelational Data Mining.

Mining Object, Spatial, Multimedia, Text, and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web.

Applications and Trends in Data Mining: Data Mining Applications, Data Mining System Products and Research Prototypes, Additional Themes on Data Mining, Social Impacts of Data Mining, Trends in Data Mining.

Reference books

1. Data Mining Concepts and Techniques: Jiawei Han and Micheline Kamber (Morgan Kaufmann Publishers).
2. Modern Data Warehousing, Mining and Visualization: George M. Marakas (Pearson Education, 2003).
3. Building the Data Warehouse: W.H.Inmon (Wiley Dreamtech, Third Edition).

Paper III: Advanced topics in Computer Science
Elective – III: Artificial Intelligence

Unit 1

Problems and search: What is Artificial Intelligence? Problems, Problem Spaces, and Search, Heuristic Search Techniques.

Unit 2

Knowledge representation: Knowledge Representation Issues, Using Predicate Logic, Representing Knowledge Using Rules, Symbolic Reasoning Under Uncertainty.

Unit 3

Statistical Reasoning, Weak Slot-and-Filler Structures, Strong Slot-and-Filler Structures, Knowledge Representation Summary.

Unit 4

Advanced topics: Game Playing, Planning, Understanding, Natural Language Processing, Parallel and Distributed AI.

Unit 5

Learning, Connectionist Models, Common Sense, Expert Systems 416, Perception and Action.

Unit 6

Fuzzy Logic Systems, Genetic Algorithms: Copying Nature's Approaches, Artificial Immune Systems, Prolog-The Natural Language of Artificial Intelligence, Conclusion.

Reference books
1. Artificial Intelligence: Kevin Knight, Elaine Rich and B. Nair, Tata McGraw Hill India, 2008.
2. Artificial Intelligence – Structures and Strategies for Complex Problem solving: George F Luger, 4th Edition, Pearson Education, Asia.
3. Introduction to Artificial Intelligence and Expert Systems: D. W. Patterson, PHI, 2nd Edition.