SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY,
VISHNUPURI, NANDED.
Curriculum and scheme of Examination of M.E. program in
Computer Science and Engineering
M.E. (CSE) (Revised) First Year

SEMESTER - I

Sr. No.	SUBJECT	TEACHING SCHEME			EXAMINATION SCHEME				
		L	PR	TOTAL	PAPER	TW	TEST	PRACT & ORAL	TOTAL
01	Research Methodology (Audit course)	02	--	02	--	50	--	--	50
02	Mathematical Foundations of Computer Science	04	--	04	100	--	25	--	125
03	Data Structures and Algorithms	04	--	04	100	--	25	--	125
04	Advanced Database Management System	04	--	04	100	--	25	--	125
05	Advanced Computer Networks	04	--	04	100	--	25	--	125
06	Elective - I	04	--	04	100	--	25	--	125
07	Computer lab - I	--	04	--	--	25	--	25	50
08	Computer lab – II	--	04	--	--	25	--	25	50
09	Seminar	--	02	--	--	50	--	--	50
	TOTAL MARKS								**825**

SEMESTER - II

Sr. No.	SUBJECT	TEACHING SCHEME			EXAMINATION SCHEME				
		L	PR	TOTAL	PAPER	TW	TEST	PRACT & ORAL	TOTAL
01	Advanced Operating System	04	--	04	100	--	25	--	125
02	Advanced Compiler Design	04	--	04	100	--	25	--	125
03	Object Oriented Software Engineering	04	--	04	100	--	25	--	125
04	Advanced Computer Architecture	04	--	04	100	--	25	--	125
05	Elective - II	04	--	04	100	--	25	--	125
06	Computer lab – III	--	04	--	--	25	--	25	50
07	Computer lab – IV	--	04	--	--	25	--	25	50
08	Mini Project	--	--	--	--	50	--	50	100
	TOTAL MARKS								**825**

ELECTIVE – I

1) Image processing
2) Soft Computing
3) Cloud Computing
4) High Performance Computing
5) Wireless &Mobile Computing

ELECTIVE – II

1) Cryptography & Network Security
2) Distributed Computing
3) Data Mining & Data Warehousing
4) Computer Vision
5) Pattern Recognition

Class Tests

The class tests are meant for continuous assessment of the students. The class tests should be evenly spread over the entire period of a term and should cover the entire syllabus. In a semester, three tests (each of one hour duration) should be conducted for each subject and average of the best two tests should be taken as class test marks in that subject.

Seminar – I

The seminar should be done on any topic in computer science & engineering to be decided by the students and the teacher concerned. Seminar work shall be in the form of report to be submitted by the students at the end of the semester. The candidate will deliver the talk on the topic for half an hour and assessment will be made by two internal examiners, one of them will be guide and the other appointed by the principal of college.

Mini Project

The student should submit a synopsis at the beginning of the semester for approval to the project committee in a specified format. The student will have to present the progress of the work through seminars and progress report. A report must be submitted to the project committee for evaluation purpose at the end of the semester in a specified format.

First Year P.G. Program in Computer Science & Engineering (Revised)

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1. Research Methodology

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Teaching Scheme   **L: 2**

Evaluation Scheme   **Theory**   **Test**   **Minimum Passing Marks**
                                                                    (Audit Course)

Course Objectives

- To familiarize the students with the
- Approach to research and its design;
- Role of methodology; and Philosophical, theoretical, ideological and originality interface with research in general and empirical research in particular.

Course Contents

UNIT I   **(5 Hrs)**

Concepts
Definition of Research, Characteristics of Research, Types of Research – Applications/Objectives/Enquiry mode, Paradigms of Research, Eight Step Research Procedure, Formulating Problem, Conceptualizing Design, Assumptions and Limitations of Problem Definition.

UNIT II   **(8 Hrs)**

Problem Definition
Literature Review, Sources of Literature, Maintain Literature data using Endnote2, Determining referencing procedure, For the Problem area to be identified, study efforts of past researchers and determine the anticipated variables to be studied. Determine the approach being developed is unique. Problem Formulation, Identifying variables to be studied, determine the scope, limitations and or assumptions, Justify basis for assumption, Formulate time plan for achieving targeted problem solution.

UNIT III   **(8 Hrs)**

Research Design
Definition Research Design and its Functions, Research Instrumentation, Availability, Training, Theoretical Conceptualization, Setting up of experiments, understanding instrumentation characteristics, focusing on the information processing with output results. Examples: DSC, SEM, FTIR etc., Data Collection Forms, Validity, Reliability of Data, Calibrating Instruments. Analytical Techniques associated with the problem formulations, Software tools required for analytical problem definition and obtaining solution.

UNIT IV (8 Hrs)

Data Analysis
Representation of size Analysis Data, Mean, Mode, Median, Data Skew ness, Histograms, Frequency Polygons and Frequency Curves, Cumulative Frequency Curve, Characteristics of Frequency Curve, Functions of Random Variables, Discrete Probability Distributions, Continuous Probability Distributions, Standard Normal Distribution, Processing Data for Editing, Coding, Developing framework for quantitative analysis, Displaying Data Histogram, Bar Chart, Stacked Bar Chart, Frequency Polygon, Pie Chart, Scatter gram. Mathematical Modeling, Statistical Modeling, Data Mining to perform predictive testing of measurable parameters of research. Measurement and scaling techniques., Use of tools like Matlab, Excel, Minitab etc.

UNIT V (8 Hrs)

Testing of Hypothesis
Parametric and Non Parametric Hypothesis, Continuous Probability Distributions, Standard Normal Distribution, Confidence Intervals, Chi-Square Tests and Multivariate Analysis, Analysis of Variances. Use of Matlab, Excel or other tools for analysis and result interpretation, Bartlett's test, Cochran's test for testing Hypothesis, Regression Analysis, Experimental Design.

UNIT VI (5 Hrs)

Review Research
Presenting research outcome at conferences and submitting papers to Journals, Identifying Journal publication procedures, Compiling Reports using Latex. Presenting Research Proposal to Internal Committee Experts, Determination of shortfalls in achieving targeted objectives, Identifying Problems and re describing final objectives, Determining Time Plan.

Recommended Books:

1. Research Methodology – A Step by Step Guide for Beginners by Ranjit Kumar, Sage Publication, ISBN, 141291194X, 9781412911948
2. Research Methodology – Methods and Techniques by C. R. Kothari, New Age International, ISBN, 8122415229, 9788122415223

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2. Mathematical Foundations of

Computer Science

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Teaching Scheme   **L: 4**

Evaluation Scheme	Theory	Test	Minimum Passing Marks
	100 Marks	25 Marks	40%

Course Objectives

- To understand the significance of number theory
- To learn different algebraic structures
- To study various concepts of linear algebra

Course Contents

UNIT I (10 Hrs)

Number theory
Divisibility, gcd, prime numbers, fundamental theorem of arithmetic, Congruences, Fermat's theorem, Euler function, primality testing, solution of congruences, Chinese remainder theorem, Wilson's theorem.

UNIT II (10 Hrs)

Algebraic Structures
Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, rings, finite fields.

UNIT III (10 Hrs)

Graph theory
Graphs, Euler tours, planar graphs, graph colouring, Hamiltonian graphs, Euler's formula, applications of Kuratowski's theorem.

UNIT IV (6 Hrs)

Linear Algebra
Functions; Linear transformations and their inverses; Properties of linear transformations; Orthogonality, Orthogonal transformations, Inner product spaces, Introduction to determinants

Eigenvectors and Eigen value

Definitions and examples of eigenvectors and eigen values; Computational methods for finding eigenvectors and eigen values; Properties of eigen vectors and eigen values; Matrix representations; Change of basis; Symmetric matrices and diagonalization.

Reference Books:

1. Niven, H.S. Zuckerman and Montgomery, An Introduction to the Theory of Numbers, 3/e, John Wiley and Sons, New York, 1992, ISBN 10: 0471546003 / *ISBN* 13: 9780471546009
2. Kolman and R.C. Busby, Discrete Mathematical Structures for Computer Science, PHI, New Delhi, 1994., ISBN 0-13-215922-8
3. J. Clark and D. A. Holton, A First Look at Graph Theory, Allied Publishers (World Scientific), New Delhi, 1991, ISBN, 9810204906, 9789810204907
4. Richard Bronson and Gabriel B. Linear Algebra: An Introduction, 1st or 2nd Edition, Costa Elsevier Academic Press, ISBN-10: 0120887843 | *ISBN*-13: 978-0120887842
5. Done Right, Sheldon Axler Linear Algebra , ISBN-10: 0387982582 | ISBN-13: 978-0387982588

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3. Data Structures and Algorithms

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Teaching Scheme	L: 4		
Evaluation Scheme	Theory	Test	Minimum Passing Marks
	100 Marks	25 Marks	40%

Course Objectives

- To learn various algorithm design techniques
- To understand advanced data structures
- To learn various algorithm analysis techniques

Course Contents

UNIT I   (6 Hrs)

Foundations
Overview of basic data structures, role of algorithm in computing, asymptotic notations, recurrences, substitution method, recursion tree method, the master method, proof of Master theorem.

UNIT II   (4 Hrs)

Probabilistic Analysis & Randomized Algorithm
The hiring problem, Indicator random variables, Randomized algorithm, probabilistic analysis.

UNIT III   (10 Hrs)

Basic algorithm techniques
Dynamic programming, greedy algorithm, theoretical foundation of greedy methods, matroids, task scheduling problem, graph algorithms, maximum flow, amortized analysis.

UNIT IV   (8 Hrs)

Advanced Data Structures
Red-Black trees, B-trees, Binomial heaps, Fibonacci heaps, Skip lists, universal hashing, Data structures for maintaining ranges, intervals and Data structures for disjoint sets.

UNIT V   **(8 Hrs)**

Complexity Classes
NP-Hard and NP-complete problems, Cook's theorem, NP completeness reductions.

UNIT VI   **(4 Hrs)**

Approximation Algorithms
Polynomial time and fully polynomial time approximation schemes.

Text Books:

1. T.H Cormen, C.E. Leiserson, R.L. Rivest, "Introduction to algorithms", 3rd Edition, Prentic Hall India Publication. (ISBN- 978-0262033848)
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 3rd Edition, Pearson Education, 2007. (ISBN-10: 032144146X,ISBN-13: 9780321441461)

Reference Books:

1. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Pearson Education, 2002.(ISBN - 978-0201000238)
2. Donald Ervin Knuth "Art of Computer Programming", Volume 1: Fundamental Algorithms(ISBN-13: 978-0201896831)
3. Horowitz, Sahni, Rajasekaran, "Computer Algorithms", Galgotia, 2000. (SBN: 8175152575)
4. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education. (ISBN:9788131702055)
5. G. Brassad and P. Bratley *"Fundamentals of Algorithms"*, PHI India,1996 (ISBN- 81-203-1131-0)
6. M. A. Weiss, *Data Structures and Algorithm Analysis in Java*, Pearson, 2003. (ISBN-13: 978-0-13-257627-7)

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4 Advanced Database Management Systems

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Teaching Scheme	**L: 4**		
Evaluation Scheme	**Theory**	**Test**	**Minimum Passing Marks**
	100 Marks	25 Marks	40%

Course Objectives

- To study parallel, object oriented and distributed architectures of database systems.
- To understand web databases using XML.
- To familiarize with mobile and multimedia database systems.

Course Contents

UNIT I   (10 Hrs)

Parallel And Distributed Databases
Database System Architectures: Centralized and Client-Server Architectures , Server System Architectures, Parallel Systems, Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism, Query Optimization, Parallelism on Multicore Processors – Distributed Database Concepts: Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design- Types of Distributed Database Systems, Query Processing in Distributed Databases, Overview of Concurrency Control and Recovery in Distributed Databases-An Overview of 3-Tier Client-Server Architecture-Distributed Databases in Oracle, Cloud-Based Databases.

UNIT II   (10 Hrs)

Object And Object Relational Databases
Concepts for Object Databases: Overview, Object Identity , Object structure, Type Constructors , Encapsulation of Operations , Methods, Persistence, Type and Class Hierarchies, Inheritance, Complex Objects , Other Objected-Oriented Concepts. Object Database Standards, Languages and Design: ODMG Model, ODL, OQL – Object Relational and Extended – Relational Systems : Overview of SQL and Its Object-Relational Features, Evolution of Data Models and Current Trends of Database Technology, The Informix Universal Server, Object Relational features of Oracle , Implementation and Related Issues for Extended Type Systems, The Nested Relational Model

UNIT III (8 Hrs)

Xml and Web Databases
Web Database: Structured, Semi structured, and Unstructured Data, A Simple PHP Example, Overview of Basic Features of PHP, Overview of PHP Database Programming
XML Databases: XML Hierarchical (Tree) Data Model, XML Documents, DTD, and XML Schema, XML Documents and Databases, XML Querying

UNIT IV (6 Hrs)

Mobile Databases
Mobile Databases: Location and Handoff Management, Effect of Mobility on Data Management – data categorization, Location Dependent Data Distribution, Mobile Transaction Models,- Concurrency Control, Transaction Commit Protocols, Mobile Database Recovery Schemes.

UNIT V (6 Hrs)

Multimedia Databases
Types of multimedia information, multimedia database applications, multimedia object characteristics, MDDMS components, Multimedia storage and retrieval, Querying MMDB, MMDBMS Architecture.

Text Books:

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education/Addison Wesley, 2009. ISBN : 978-81-317-1625-0
2. Vijay Kumar, " Mobile Database Systems", John Wiley & Sons, 2006. ISBN : 13 978-0-4714-6792-2
3. Multimedia Database Management Systems by B. Prabhakaran ISBN: 8181286529, 9788181286529

Reference Books:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", 6th Edition, McGraw Hill, 2006. ISBN: 9780071289597
2. Thomas Cannolly and Carolyn Begg, " Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007. ISBN: 978-0201342871
3. C.J.Date, A.Kannan and S.Swamynathan,"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006. ISBN: 9788177585568
4. V.S.Subramanian, "Principles of Multimedia Database Systems", Harcourt India Pvt Ltd., 2001. ISBN-13: 978-1558604667.

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5   Advanced Computer Networks

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Teaching Scheme   **L: 4**

Evaluation Scheme	Theory	Test	Minimum Passing Marks
	100 Marks	25 Marks	40%

Course Objectives
- To have succinct and in-depth study of IPv6 features and functions.
- Understand and learn to plan, design and integrate IPv6 with current IPv4 infrastructure.
- To acquaint with high speed networks such as SONET, ATM, BISDN and DWDM

Course Contents

UNIT-I   (8 Hrs)

Why IPv6: What's New in IPv6?, Why Do We Need IPv6?, When Is It Time for IPv6? The Structure of the IPv6 Protocol: General Header Structure, the Fields in the IPv6 Header, Extension Headers. IPv6 Addressing: The IPv6 Address Space, Address Types, Address Notation, Prefix Notation, Global Routing Prefixes, Global Unicast Address, Special Addresses, Link- and Site-Local Addresses, Anycast Addresses, Multicast Address, Required Addresses, Default Address Selection.

UNIT-II   (10 Hrs)

Interoperability: Dual-Stack Techniques, Tunneling Techniques, Network Address and Protocol Translation, Comparison, ICMPv6: General Message Format, ICMP Error Messages, ICMP Informational Messages, Processing Rules, The ICMPv6 Header in a Trace File, Neighbor Discovery (ND), Autoconfiguration, Network Renumbering, Path MTU Discovery, Multicast Listener Discovery (MLD), Multicast Router Discovery (MRD).

UNIT-III   (8 Hrs)

Networking Aspects: Layer 2 Support for IPv6, Detecting Network Attachment (DNA). Routing Protocols: The Routing Table, RIPng, OSPF for IPv6 (OSPFv3), BGP-4 Support for IPv6, Additional Routing Protocols for IPv6.

UNIT-IV   **(6 Hrs)**

Upper-Layer Protocols: UDP/TCP, DHCP, DNS, SLP, FTP, Telnet, Web Servers
IPv6 Quality of Service: QoS Basics, QoS in IPv6 Protocols, Using QoS

UNIT V   **(8 Hrs)**

Network Services and Layered Architectures**:** Applications, Traffic Characterization   and Quality of Service, Network Services, High -Performance Networks, Network Elements, Basic Network Mechanisms, Network Elements, Basic Network Mechanisms, Layered Architecture, Open Data Network Model, Network Architectures.

UNIT VI   **(8 Hrs)**

Performance of Circuit-Switched Networks: SONET, Dense Wave-Division Multiplexing (DWDM), Fiber to the Home, Digital Subscriber Line (DSL), Intelligent Networks, CATV, Asynchronous Transfer Mode**:** Main Features of ATM, Addressing, Signaling , and Routing, ATM Header Structure,   ATM Adaptation Layer, Management and Control, BISDN, Internetworking with ATM,

Text Books:

1. IPv6 Essentials, 2nd Edition by Silvia Hagen, O' Reilly Publications.   ISBN: 0-596-10058-2.
2. Walrand.J. Varaiya, High Performance Communication Network, Morgan Kauffman - Harcourt Asia Pvt Ltd, 2nd Edition, 2000. ISBN: 1-55860-654-8

 Reference Books:

1. William Stallings ISDN & Broadband ISDN with frame Relay & ATM, PHI 4th Edtion 2000. ISBN : 978-81-7758-569-8
2. Uyless Black Emerging Communications Technologies2/e Prentice Hall 1997. ISBN : 0-13-014248-4
3. Bates & Donald W.Gregory Voice & Data Communications Handbook, Mc-Graw Hill, Edition, 3rd edition 2000. ISBN-13: 978-0-07-064766-4
4. Silvano gai, " Internetworking IPV6 with CISCO Routers" , McGraw– Hill Computer Communication series. ISBN: 978-0-07-022836-8.

First Year P.G. Program in Computer Science & Engineering (Revised)

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ELECTIVE-I
1. Image Processing
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Teaching Scheme   **L: 4**

Evaluation Scheme	Theory	Test	Minimum Passing Marks
	100 Marks	25 Marks	40%

Course Objectives

- Develop an overview of the field of image processing.
- Cover the basic theory and algorithms that are widely used in digital image processing.
- Develop hands-on experience in using computers to process images.
- Familiarize with MATLAB Image Processing Toolbox

Course Contents

UNIT I (8 Hrs)

Introduction:
What is image processing? , What are the fundamental issues? , What is the role of perception? Image sampling and quantization, Basic relationship between pixels, MATLAB orientations.

Image Transformations
Discrete Fourier transform, Properties of 2D DFT, FFT, Convolution, Correlation, Discrete cosine transform, Discrete Wavelet transform.

UNIT III (8 Hrs)

Image Enhancement Techniques
Spatial Domain Techniques: Basic gray level transformations, Histogram processing, Image subtraction, Image averaging, Spatial filtering, Smoothing filters, Sharpening filters.
Frequency Domain Techniques: Frequency domain filtering, Image smoothing and Image sharpening using frequency domain filters.

UNIT IV (4 Hrs)

Color image processing:
Color fundamentals, Color models, Color transformation, Smoothing and Sharpening.

UNIT V (7 Hrs)

Image Compression:
Fundamentals, Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Huffman coding, Arithmetic coding, Golomb coding, LZW coding, Block transform coding, Run-length coding, JPEG Lossless predictive coding, Lossy predictive coding, Wavelet coding.

UNIT VI (6 Hrs)

Morphological Image processing:
Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Hole filling, Connected components, Convex hull, Thinning, Thickening, Skeletons, Pruning.

UNIT VII (7 Hrs)

Image Segmentation and Representation:
Point, Line and Edge detection, Edge linking and Boundary detection, Thresholding, Basic global tresholding, Otsu's method, Region based segmentation, Use of motion in segmentation.

Text Books:

1. R. C. Gonzalez and Richard E Woods, "Digital Image Processing", 3'rd Edition, Pearson Education. ISBN 978-81-317-1934-3, 2008.

Reference Books :

1. R.C. Gonzalez and R.E. Woods, "Digital Image Processing Using Matlab", Pearson Education
2. R.C. Gonzalez and R.E. Woods, "Digital Image Processing", 1'st Edition, Pearson Education.
3. A.K. Jain, " Fundamentals of Digital Image Processing", Prentice Hall India, K.R. Castleman, " Digital Image Processing", Pearson education, 2007, ISBN 81-317-1286-

First Year P.G. Program in Computer Science & Engineering (Revised)

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ELECTIVE-I
2. Soft Computing
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Teaching Scheme	L: 4		
Evaluation Scheme	Theory	Test	Minimum Passing Marks
	100 Marks	25 Marks	40%

Course Objectives

- To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To familiarize with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations
- To introduce case studies utilizing the above and illustrate the intelligent behavior of programs based on soft computing

Course Contents

UNIT I   (10 Hrs)

Fuzzy Set Theory
Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and
Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization –
Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then
Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy
Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II   (8 Hrs)

Optimization
Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical
Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms
– Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT III   (10 Hrs)

Neural Networks

Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer
Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks –
Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector
Quantization – Hebbian Learning.

UNIT IV   (9 Hrs)

Neuro Fuzzy Modeling

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning
Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework
Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT V   (8 Hrs)

Applications of Computational Intelligence

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency
Prediction – Soft Computing for Color Recipe Prediction.

Text Books:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson
   Education 2004, ISBN: 978-988-98671-0-2.

Reference Books:
1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997, ISBN 0-
    07-053917-0.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning",
    AddisonWesley, N.Y., 1989, ISBN: 0201157675
3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms",
    PHI, 2003, ISBN 81-7758-372-7
4. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP
    Professional, Boston, 1996, ISBN 007 709506 5

ELECTIVE-I
3. Cloud Computing

Teaching Scheme   **L: 4**

Evaluation Scheme	**Theory**	**Test**	**Minimum Passing Marks**
	100 Marks	25 Marks	40%

Course Objectives

- To understand the emerging area of cloud computing, IT outsourcing, application virtualization and how it relates to traditional models of computing.
- To gain competence in Map Reduce as a programming model for distributed processing of large datasets. Specifically:
- To understand and be able to articulate key concepts behind Map Reduce, including its functional abstraction, the use of distributed storage, and the scheduling of data-local jobs.
- To understand how well-known algorithms such as Page Rank and inverted index construction can be expressed in the Map Reduce framework.
- To gain competence in Ajax as a vehicle for delivering highly-interactive Web applications.

Course Contents

UNIT I   (6 Hrs)

Cloud Computing Basics
Cloud Computing Overview, What Is Cloud Computing?, Cloud Components, Infrastructure, Services, Applications, Storage, Database Services, Intranets and the Cloud, Components, Hypervisor Applications, First Movers in the Cloud, Amazon, Google, Microsoft, SaaS architecture, Dev 2.0 platforms, cloud models.

UNIT II   (8 Hrs)

Cloud Computing Platforms
Infrastructure as a service: Amazon EC2, Platform as a service: Google App Engine, Microsoft Azure, Amazon Simple Storage Service (Amazon S3), Amazon CloudFront, Amazon Simple Queue Service (Amazon SQS), Elastic Block Store, Salesforce.com, Force.com, Salesforce.com CRM, AppExchange, IBM Services, Cloud Computing economics.

UNIT III   **(8 Hrs)**

Cloud Technologies
SOAP and REST, SOAP versus REST, AJAX, Mashups, Virtualization, Why Virtualize?, How to Virtualize, Concerns, Security, Server Solutions, Microsoft Hyper-V, VMware, VMware Infrastructure, Virtualization Technology – VM Technology, applications, pitfalls. Multi-Tenant software. Web Application Framework, Web Hosting Service, Proprietary Methods, Web Applications, Sample Apps, Cloud APIs.

UNIT IV   **(10 Hrs)**

Cloud Development
Data in the cloud: RDBMs, GFS and HDFS, BigTable, Hbase and Dynamo, Cloud Datastore-Datastore and SimpleDB, MapReduce and extensions, Dev 2.0 Platforms. Enterprise software, Custom Enterprise Applications and Dev 2.0, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem, Roadmap for enterprise cloud Computing.

UNIT V   **(8 Hrs)**

Cloud Security
Cloud Information Security objectives, Cloud Security Services, Cloud Security Design Principles, Secure Cloud Software requirements, Threats to Infrastructure , data and access control, Cloud Service Providers risks, Identity management and access control.

Text Books:

1. Anothony T Velte, Toby J Velte, Robert Elsenpeter, *Cloud Computing : A Practical pproach*, MGH, 2010. ISBN: 978-0-07-162695-8
2. Gautam Shroff, *Enterprise Cloud Computing*, Cambridge, 2010 , ISBN 978-0-521-76095-9
3. Ronald Krutz and Russell Dean Vines, *Cloud Security*, 1/e, Wiley, 2010 , ISBN: 978-0-470-58987-8

References Books:

1. Judith Hurwitz, R Bloor, M Kanfman, F Halper, *Cloud Computing for Dummies*, 1/e, Wiley Publishers, 2009. ISBN: 978-0-470-63881-1

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ELECTIVE-I

4. High Performance Computing

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Teaching Scheme	**L: 4**		
Evaluation Scheme	**Theory**	**Test**	**Minimum Passing Marks**
	100 Marks	25 Marks	40%

Course Objectives
- To learn the parallel concepts and architectures.
- To study OpenCL
- To familiarize with CUDA architecture.

Course Contents

UNIT – I (8 Hrs)

Parallel Processing Concepts : Introduction - Levels of parallelism, instruction, transaction, task, thread, memory, function- Models, SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation -Architectures: N-wide superscalar architectures, multi-core, multi- threaded.

UNIT – II (10 Hrs)

Introduction to CUDA : Data Parallelism; CUDA Program Structure; A Matrix-Matrix Multiplication Example; Device Memories and Data Transfer; Kernel Functions and Threading; Function declarations; Kernel launch; Predefined variables; Runtime API.CUDA Thread Organization; Using block Id X and thread Id x ; Synchronization and Transparent Scalability; Thread Assignment ; Thread Scheduling and Latency Tolerance.

UNIT – III (10 Hrs)

Parallel Programming with CUDA : Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Microarchitecture and Intel Nehalem micro architecture) - Memory hierarchy and transaction specific memory design - Thread Organization

UNIT – IV   **(8 Hrs)**

Introduction to OpenCL : OpenCL basics: devices, 4 models, kernel basics – Organization of an OpenCL program: kernel, platforms, devices, context, program, command queue, buffer read / write, release resources –Performance analysis of OpenCL programs – Examples in OpenCL

UNIT – V   **(6 Hrs)**

Case studies – Applications like Matrix multiplication, Matrix MRI reconstruction Molecular Visualization and Gaming.

Reference Books:

1. David B Kirk and Wen Mei W Hwu: Programming Massively Parallel Processors: A Hands-On Approach, Elsevier India Private Limited, 2010 ISBN: 9789380501512
2. Benedict Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry, Dana Schaa,―Heterogenous Computing with OpenCL , Morgan Kaufmann, August 2011, ISBN: 978-0123877666
3. "Highly Parallel Computing", by George S. Almasi and Alan Gottlieb ISBN*:* 9780805304435
4. "Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang, McGraw Hill 1993 ISBN*:* 9780805304435
5. "Parallel Computer Architecture: A hardware/Software Approach", by David Culler Jaswinder Pal Singh, Morgan Kaufmann, 1999. ISBN: 9781558603431
6. "Scalable Parallel Computing", by Kai Hwang, McGraw Hill 1998. ISBN: 9780070317987
7. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey, © 2003. ISBN*: 978*-0201648652
8. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007. ISBN: 978-1584889090

Reference Websites:

1. http://www.nvidia.co.in/object/cuda_home_new_in.html
2. http://www.cs.cmu.edu/~scandal/nesl/algorithms.html

Reference Tools:

1. AMD APP SDK Installation Notes
2. OpenCL University Kit, http://developer.amd.com/downloads/opencl_univ_kit_1.0.zip
3. AMD APP OpenCL Programming Guide, May 2011.
4. Introduction to OpenCL Programming, Training Guide, May 2010.

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ELECTIVE-I

5. Wireless And Mobile Computing

Teaching Scheme	L: 4		
Evaluation Scheme	Theory	Test	Minimum Passing Marks
	100 Marks	25 Marks	40%

Course Objectives
- To explore the trends in wireless and mobile computing.
- To study the cellular networks including 3G
- To familiarize with the mobile device technologies.

Course Contents

UNIT I (4 Hrs)

Introduction: Definition, Applications, Mobile and wireless devices, reference model, frequencies for radio transmission, Signals, Antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular systems, motivation for specialized MAC, SDMA, FDMA, TDMA-fixed TDMA, classical aloha, slotted aloha, CSMA, DAMA, PRMA, reservation TDMA, MACA, polling, CDMA.

UNIT II (6 Hrs)

Cellular System fundamentals: Frequency reuse, handoff strategies, interference and system capacity, improving coverage and capacity.
GSM: services and features, system architecture, radio subsystem, channel types, frame structure, signal processing in GSM.

UNIT III (8 Hrs)

Third Generation (3G) Cellular Systems: Introduction, 3G Concerns, 3G Spectrum Allocation, Third Generation Service Classes and Applications, Third Generation Standards.
Fourth Generation (4G) Systems and Beyond: Introduction, Design Goals for 4G and Beyond and Related Research Issues, Orthogonal Frequency Division Multiplexing (OFDM), 4G Services and Applications, Challenges: Predicting the Future of Wireless Systems.

UNIT IV   **(8 Hrs)**

WLAN: Infra red vs radio, Infrastructure and ad-hoc, IEEE 802.11- system architecture, protocol architecture, physical layer, MAC layer, MAC management.
Mobile Network and Transport Layer: Mobile IP, Traditional TCP and Classical TCP improvements.

UNIT V   **(8 Hrs)**

Mobile Device Technology: Hardware, Human-machine interface, Operating Systems-Palm OS, EPOC, Windows CE, QNX Nutrino, BeOS, Embedded Linux, Java for Pervasive devices. Introduction to Android Platform

UNIT VI   **(6 Hrs)**

WAP: Introduction, Architecture, Infrastructure, Security issues, WML, Pervasive Web Application architecture, Open research topics in mobile computing.

Text Books:

1. Schiller, "Mobile Communication", Second Edition, Pearson Publication, 2009. ISBN: 978-81-317-2426-2
2. T. S. Rappaport " Wireless Communication: Principles and Practice" Second Edition, Pearson 2010.ISBN: 978-81-317-3186-4
3. P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou,A. S. Pomportsis " WIRELESS NETWORKS " , John Wiley ISBN: 047085801X
4. J Burkhardt, H Henn, S Hepper et al, " Pervasive Computing: Technology and Architecture of Mobile Internet Applications", Pearson 2006.ISBN: 978-0201722154

References Books:

1. Asoke Talkukder, Roopa R Yavagal, "Mobile Computing – Technology, Applications   and Service Creation", Tata McGraw Hill, 2007 ISBN: 978-0-07-058807-3
2. Reza B'Far, "Mobile Computing Principles – Designing and Developing Mobile Applications with UML and XML",Cambridge University press, 5th Edition, 2006.ISBN: 978-0521817332
3. Uwe Hansmann, Lothat Merk, Martin S Nicklous and Thomas Stober, Principles of Mobile Computing", Springer International Edition, Second Edition, 2005 ISBN:978- 81-8128-073-2
4. ProAndroid 2 by Sayed Hashimi, Satya Komatineni, ISBN: 978-1430226598

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1. COMPUTER LAB-I

Teaching Scheme	PR: 4		
Evaluation Scheme	**Practical**	**Termwork**	**Minimum Passing Marks**
	25 Marks	25 Marks	40%

Computer Lab –I shall be based on the subjects Data Structures & Algorithm and Advanced Computer Networks.

Term Work:
The Term Work shall consist of at least 8 programs/assignment or one small project for each subject. The experiments shall be evenly spread over the entire syllabus.

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2. COMPUTER LAB-II

Teaching Scheme	PR: 4		
Evaluation Scheme	**Practical**	**Termwork**	**Minimum Passing Marks**
	25 Marks	25 Marks	40%

Computer Lab – II shall be based on the subjects Advanced Database Management Systems and Elective – I.

Term Work:
The Term Work shall consist of at least 8 programs/assignment or one small project for each subject. The experiments shall be evenly spread over the entire syllabus.