SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR

An Autonomous College of Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur, Maharashtra, India

TEACHING SCHEME & SYLLABUS
2014-15

M. TECH. COMPUTER SCIENCE AND ENGINEERING

Published by
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ISO 9001 : 2008 CERTIFIED ORGANISATION

Department Vision

To achieve excellent standard of quality education & become leader in providing academic proficiency in scientific & technical education and research; to serve as valuable resource for Industry and Society.

Department Mission

To generate new knowledge by engaging in cutting-edge research and to promote academic growth by offering state-of-the-art postgraduate programmes.

To pursue research and disseminate research findings.

To provide knowledge-based technological services to satisfy the needs of society and the industry.

To help in building national capabilities in science, technology, humanities, management, education and research.

Programme Educational Objectives (PEOs)

The Post-graduates shall :

1. Apply analysis, design, optimization and implementation skills in order to formulate and solve Computer Science and Engineering and multidisciplinary problems
2. Learn to apply modern skills, techniques, and engineering tools to create computational systems. Understand the state of the art in the recent areas of research in computer science and engineering and to formulate problems from them and perform original work to contribute in the advancement of the state of the art.
3. Use their skills in ethical & professional manner to raise the satisfaction level of stake holders.

Programme Outcomes (POs)

1) To obtain sound knowledge in the theory, principles and applications of computer systems.
2) Apply knowledge of mathematics, science, and engineering in the design and development of software systems.
3) Configure recent software tools, apply test conditions, and deploy and manage them on computer systems.
4) Perform experiments on different software packages either obtain from external parties ordeveloped by themselves and analyses the experimental results.

5) Design and develop software projects given their specifications and within performance and cost constraints.

6) Identify, formulate and solve software engineering problems and understand the software project management principles.

7) Ability to understand the computing needs of inter-disciplinary scientific and engineeringdisciplines and design and develop algorithms and techniques for achieving these.

8) Acquire and understand new knowledge, use them to develop software products, and to understand the importance of lifelong learning.

9) Ability to extend the state of art in some of the areas of interest and create new knowledge.

10) Communicate effectively in oral, written and graphical form.

11) Work cooperatively, responsibly, creatively, and respectfully in teams.

12) Understand professional and ethical responsibilities and analyze the impact of computing on individuals, organizations, and the society.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Teaching Scheme for First Year (Semester I) Master of Technology

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	CST501	Advanced Computer Architecture	4	0	0	8	40	60	100	3 Hours
2	CST502	Software Architecture	4	0	0	8	40	60	100	3 Hours
3	CSP502	Software Architecture	0	0	2	2	25	25	50	2 Hours*
4	CST503	Advances in Algorithms	4	0	0	8	40	60	100	3 Hours
5	CST504	Mobile Applications Design	4	0	0	8	40	60	100	3 Hours
6	CSP504	Mobile Applications Design	0	0	2	2	25	25	50	2 Hours*
7	CST505	Elective-I	4	0	0	8	40	60	100	3 Hours
		TOTAL	**20**	**0**	**4**	**44**	**250**			

Course code	Elective-I
CST505-1	Graph Mining
CST505-2	Pattern Recognition
CST505-3	Advance topics in networking

* May vary as per requirements

Teaching Scheme for First Year (Semester II) Master of Technology

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
8	CST506	Compiling For High Performance Architecture	4	0	0	8	40	60	100	3 Hours
9	CSP506	Compiling For High Performance Architecture	0	0	2	2	25	25	50	2 Hours*
10	CST507	Advanced Digital Image Processing	4	0	0	8	40	60	100	3 Hours
11	CSP507	Advanced Digital Image Processing	0	0	2	2	25	25	50	2 Hours*
12	CST508	Data Management Techniques	3	0	0	6	40	60	100	3 Hours
13	CST509	Cryptography	4	0	0	8	40	60	100	3 Hours
14	CST510	Elective-II	4	0	0	8	40	60	100	3 Hours
15	CST511	Seminar	0	0	2	2	50	50	100	--
		TOTAL	**20**	**0**	**6**	**44**	**300**			

* May vary as per requirements

Course code	Elective-II
CST510-1	Statistical Machine Learning
CST510-2	Middleware technologies in Web and Mobile domain
CST510-3	Parallel Algorithms

Teaching Scheme for Second Year (Semester III) Master of Technology

Sr. No.	Course Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	CST601	Research Methodology	3	0	0	6	40	60	100	3 Hrs.
2	CST602	Elective-III	4	0	0	8	40	60	100	3 Hrs.
3	CST603	Elective-IV	3	0	0	6	40	60	100	3 Hrs.
4	CST604	Project Phase-I	0	0	6	24	50	50	100	--
		TOTAL	**10**	**0**	**6**	**44**	**170**			

Course Code	Elective - III	Course Code	Elective - IV
CST602-4	Big Data Analytics	CST603-4	Reconfigurable and Cloud Computing
CST602-5	Advance topics in Security	CST603-2	Wireless Sensor Networks
CST602-6	Social Network Analysis	CST603-5	Information Retrieval
CST602-7	Biometrics	CST603-6	Ubiquitous Computing

Teaching Scheme for Second Year (Semester IV) Master of Technology

Sr. No.	Course Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
20	CST605	Project Phase - II	0	0	12	48	150	250	400	--
		TOTAL	**0**	**0**	**12**	**48**			**400**	

I SEMESTER

Course Code .: CST501 | **Course : Advanced Computer Architecture**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week | **Total Credits : 08**

Course Outcomes :

On successful completion of the course, students will be able to:

1 Able to know the classes of computers, and new trends and developments in computer architecture

2 Able to describe the principles of computer design, understand pipelining, instruction set architectures, memory addressing.

3 Able to describe the operation of performance enhancements such as pipelines, dynamic scheduling, branch prediction, caches, and vector processors.

4 Able to describe modern architectures such as RISC, Super Scalar, VLIW (very large instruction word), multi-core and multi-cpu systems.

5 Able to compare the performance of different architectures and their applications.

Course Syllabus :

Parallel Computer Models : The state of computing, Multiprocessors and multi-computers, Multivector and SIMD computers, Architectural development tracks. Program And Network Properties: Conditions of parallelism, Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Program flow mechanisms, Control flow versus data flow, Data flow architecture, Demand driven mechanisms, Comparisons of flow mechanisms.

System Interconnect Architectures: Network properties and routing, Static interconnection networks, Dynamic interconnection Networks, Multiprocessor system interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.

Processors and Memory Hierarchy: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors, Pipelining, Basic concepts, instruction and arithmetic pipeline, data hazards, Exception handling, Pipeline optimization techniques, Compiler techniques for improving performance,

Memory Technology: Hierarchical memory technology, Inclusion, Coherence and Locality, Memory capacity planning, Virtual Memory Technology. Backplane Bus System: Backplane bus specification, Addressing and timing protocols, Arbitration transaction and interrupt, Cache addressing models, direct mapping and associative caches.

Pipelining and Instruction-level parallelism: Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch handling techniques, Arithmetic Pipeline Design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipelines. ILP, Techniques for increasing ILP, super scalar, super pipelined and VLIW processor architectures,

Multi-core/Many-core Architectures: Array and vector processors, Multiprocessor architecture, taxonomy of

parallel architectures, centralized shared-memory architecture, synchronization, memory consistency, interconnection networks, Distributed shared-memory architecture, Cluster computers, Non von Neumann architectures, data flow computers, reduction computer architectures, systolic architectures. GPGPU architecture: GPU basics and architecture, Graphics and Computing.

Text and Reference Books :

1. Kai Hwang, "Advanced Computer Architecture"; TMH.
2. J. P. Hayes, "Computer Architecture And Organization"; MGH.
3. Harvey G. Cragon, "Memory System and Pipelined Processors"; Narosa Publication.
4. V. Rajaranam & C.S.R.Murthy, "Parallel Computer"; PHI.
5. R. K. Ghose, Rajan Moona & Phalguni Gupta, "Foundation of Parallel Processing"; Narosa Publications.
6. Kai Hwang and Zu, "Scalable Parallel Computers Architecture"; MGH.
7. Randi J. Rost, "OpenGL Shading Language", Third Edition.
8. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", First Edition, ISBN-10: 123814723, ISBN-13: 978-0-12-381472-2, Morgan Kauffman, 2010.

Course Code .: CST502 **Course : Software Architecture**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Argue the importance and role of software architecture in large scale software systems
2. Design and motivate software architecture for large scale software systems
3. Recognize major software architectural styles, design patterns, and frameworks
4. Describe a software architecture using various documentation approaches and architectural description languages
5. Generate architectural alternatives for a problem and select among them
6. Use well-understood paradigms for designing new systems
7. Identify and assess the quality attributes of a system at the architectural level
8. Motivate the architectural concerns and approach for families of products
9. Discuss and evaluate the current trends and technologies such as model-driven, service-oriented, and aspect-oriented architectures
10. Evaluate the coming attractions in software architecture research and practice

Course Syllabus :

Systems engineering and software architectures; HatleyPirbhai architectural template; architectural flow diagrams;

Requirements engineering and software architecture; architectural design processes; real-time architectures;

Architectural design patterns; Pattern Systems, Patterns and Software architecture.

Software architecture and maintenance management;

Object oriented architectures; client server architectures;

Forward engineering for object oriented and client server architectures; emerging software architectures.

Reference Books:

1. Software Architecture in Practice 2nd ed.: Bass, Len & others.. Pearson Edu., (2003).
2. Pattern Oriented Software Architecture Vol. I: Buschmann, F. WSE, (1996).
3. The Art of Software Architecture: Stephen T. Albin, Wiley dreamtech, (2003).
4. Large Scale Software Architecture: A Practical Guide Using UM: Jeff Garland, Richard Anthony, Wiley dreamtech, (2003).
5. Software Architecture – Perspectives on an Emerging Discipline: Mary Shaw & David Garlan, , PHI, (1996).
6. Design Patterns : Elements of Reusable Object Oriented Software: Gamma, E. et. Al., Addison Wesley, (1995).
7. Software Engineering 7th ed.: Ian Sommerville, Addison Wesley, 2004.

Course Code .: CSP502 **Course : Software Architecture Lab**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Syllabus:

The instructor should design the practical such that the student should be able:

- To illustrate the current state of the discipline of Software Architecture and examine the ways in which architectural design can affect software design.
- To study the various architectural styles used in software engineering.
- To understand the evaluate designs of existing software systems from an architectural perspective.
- To provide the intellectual building blocks for designing new systems in principled ways, using well-understood architectural paradigms.
- To present concrete examples of actual system architectures that can serve as model for new designs.

Course Code .: CST503 **Course : Advances in Algorithm**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Understand the algorithm design paradigm, methods of analysis of algorithms and classify algorithms in P and NP domains.
2. Understand applications of algorithms in real life problems, like searching, social network analysis, constraint handling and implementation of algorithms for distributed and parallel systems.
3. Understand the application of algorithms in Internet programming, design of search engines and data compression.
4. Understand the applications of randomized algorithms in Graph domains to improve complexity.
5. Understand the applications of Geometric algorithms in real life problem solving like road traffic analysis, ad-hoc sensor networks.
6. Understand various numerical algorithms and their applications.

Course Syllabus

Algorithmic paradigms: Dynamic Programming, Greedy, Branch-and-Bound.

Asymptotic complexity, Amortized analysis.

Graph Algorithms, Shortest paths, Flow networks,

NP-completeness.

Approximation algorithms, Randomized algorithms, Linear programming.

Geometric algorithms (range searching, convex hulls, segment intersections, closest pairs),

Numerical algorithms (integer, matrix and polynomial multiplication, FFT, extended Euclid's algorithm, modular exponentiation, primarily testing, cryptographic computations),

Internet algorithms (text pattern matching, tries, information retrieval, data compression, Web caching).

Text and String handling Algorithms: Naive algorithm, Knuth-Morris-Pratt Algorithm, Boyer-Moore-Algorithm, Krapp-Rabin Algorithm, Approximate String Matching.

Parallel Algorithms and Architectures: Approaches to Design of Parallel Algorithm, Performance Measures of Parallel Algorithm, Parallel Sorting.

Distributed Computation Algorithm: SPMD Distributed Computation Model, Message Passing, Distribution Even-Odd Transposition Sort, Distributed Depth First Search.

Text and Reference Books:

1. Fundamentals of Computer Algorithms by Horowitz and Sahani, University Press
2. Introduction to Algorithm by Cormen, Rivest and Stein, PHI Publications-New Delhi, Second Edition
3. Design and Analysis of Computer Algorithms byA.Aho and John Hopcroft, Pearson Education, India.
   Algorithm Design by Jon Kleinberg and Eva Tardus, Pearson Education, India.

Course Code .: CST504 | **Course : Mobile Application Design**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week | **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1 Understand the evolution, ecosystem and scope of Mobile application in current context.
2 Develop strategy for mobile application design.
3 Understand and design information architecture for mobile environment.
4 Use different tools available for mobile design.
5 Use different testing and adapting technologies for mobile applications.

Course Syllabus

A Brief History of Mobile: In the Beginning, The Evolution of Devices. The Mobile Ecosystem: Operators, Networks, Devices, Platforms, Operating Systems, Application Frameworks, Applications, Services. Size and Scope of the Mobile Market, The Addressable Mobile Market, Mobile As a Medium, The Eighth Mass Medium: Ubiquity Starts with the Mobile Web. Designing for Context: Thinking in Context, Taking the Next Steps.

Developing a Mobile Strategy: New Rules. Types of Mobile Applications: Mobile Application Medium Types. Mobile Information Architecture: What Is Information Architecture?, Mobile Information Architecture, The Design Myth.

Mobile Design: Interpreting Design, The Mobile Design Tent-Pole, Designing for the Best Possible Experience, The Elements of Mobile Design, Mobile Design Tools, Designing for the Right Device, Designing for Different Screen Sizes.

Mobile Web Apps Versus Native Applications: The Ubiquity Principle, When to Make a Native Application, Mobile 2.0. Mobile Web Development: Web Standards, Designing for Multiple Mobile Browsers, Device Plans, Markup, CSS: Cascading Style Sheets, JavaScript.

iPhone Web Apps: WebKit, Mobile Web App, Markup, CSS, JavaScript, Creating a Mobile Web App, Web Apps As Native Apps, PhoneGap, Tools and Libraries.

Adapting to Devices: Adaptation a Necessity, Do Nothing, Progressive Enhancement, Device Targeting, Full Adaptation, Domain to Use, Taking the Next Step.Working with Operators, Working with an App Store, Add Advertising, Invent a New Model. Supporting Devices: Having a Device Plan, Device Testing, Desktop Testing, Usability Testing. The Future of Mobile: The Opportunity for Change.

Text Books:

1 Brian Fling, Mobile Design and Development: Practical concepts and techniques for creating mobile sites and web apps, O'Reilly Media, August 2009.

Course Code .: CSP504 **Course : Mobile Application Design Lab**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Syllabus :

The instructor should design the practical such that the student should be able:

- To study and understand the mobile application architecture.
- To illustrate the knowledge base earned after studying this course.
- To develop the simple mobile application.
- To develop the complex mobile application.

Course Code .: CST505 -1 (Elective-I) **Course : Graph Mining**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Understand the basic of Graph as data structure, terminology of graph, different types of graphs and graph traversals.
2. Understand the basic of Tree as data structure, types of trees, mathematical enumeration of trees using various formulations.
3. Applications of bipartite graph, Euler's graph, Hamiltonian graphs.
4. Applications of k-connected networks, k-connected graphs, maximum flow networks, stable matching.
5. Implementation of various theorems like: Berge's theorem, Vizing theorem, Brooks theorem and applications in graph mining.
6. Implementation and application of chromatic polynomial and chromatic graphs in data mining.
7. Implementation of planar graph, Five color and four color graphs theorem, dual graphs representation and applications in data mining.

Course Syllabus

Graphs and their applications, Incidence, degree, vertex, directed and undirected graphs, null graph, sub graphs, union of graphs, isomorphism, walks, connected graphs, paths, circuits, disconnected graphs, Bipartite graphs, Euler's graphs, Hamiltonian graphs.

Properties of trees, rooted trees, binary trees, spanning trees, minimum spanning trees fundamental circuits, enumeration of trees: Cayley formula, the Matrix-Tree theorem

Vertex and Edge connectivity, Menger theorem, cuts, blocks, k-connected graphs, network flows

Maximum matching in bipartite and general graphs, Berge's Theorem, algorithms for matching and weighted matching (in both bipartite and general graphs)stable matching, vertex and edge Coverings,

Vertex and edge coloring, Brook's theorem, the greedy algorithm, the Welsh-Powell bound, critical Chromatic polynomial and chromatic recurrence graphs, Vizing theorem

Planer graphs and their representation, Dual graphs, Detection of planarity, Five-color and Four-color theorem, Thickness and crossing. Advanced topics (perfect graphs, Metroid's, Ramsay theory, external graphs, random graphs); Applications.

Text and Reference Books:

1. Graph Theory with Applications to Engineering and Computer Science, NarsinghDeo, PHI.
2. Mining Graph Data, L. B. Cook and D. J. Holder, Wiley Publications India.
3. Introduction to Graph Theory, Gary Chartrand and Ping Zhang, McGraw Hill Higher Education.

Course Code .: CST505 -2 **Course : Pattern Recognition**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Understand the application of Bayes decision theory in real life applications like classifier design, and estimation of error rate.
2. Understand applications of machine learning algorithms like PCA, expectation Maximization, Hidden Markov models, and Bayesian parameter estimation.
3. Understand the application of Non parametric technique like histogram estimation, kernel and window estimator, Density estimation, Adaptive discriminant function.
4. Understand the application of Discriminative methods such as nearest neighbor classification, Metric and Tangent distance, and Fuzzy Classification.
5. Understand the application of support vector machine, minimum squared error procedure.
6. Understand the applications of Artificial neural network like Back propagation algorithm in classifier design.
7. Understand the application of string matching algorithms in pattern recognition.
8. Understand the application of Algorithm independent machine learning and Unsupervised
9. Learning (clustering) in pattern classifier.

Course Syllabus

Introduction: Bayes Decision Theory: Bayes Decision Rule, Minimum Error Rate Classification, Normal Density and Discriminant Functions, Error Integrals and Bounds, Bayesian Networks, Compound Decision Theory.

Generative Methods : Maximum-Likelihood and Bayesian Parameter Estimation: Maximum-Likelihood Estimation, Bayesian Parameter Estimation, Sufficient Statistics,Some Common Statistical Distributions, Dimensionality and Computational Complexity,Principal Components Analysis, Fisher Linear Discriminant, Expectation Maximization,Sequential Data and Hidden Markov Models.

Nonparametric Techniques : Density Estimation.

Discriminative Methods : Distance-based Methods: Nearest neighbor Classification, Metrics and Tangent Distance, Fuzzy Classification.

Linear Discriminant Functions : Hyper plane Geometry, Gradient Descent and perceptrons, Minimum Squared Error Procedures, Support Vector Machines.

Artificial Neural Networks: Biological Motivation and Back-Propagation.

Non-Metric Methods: Recognition with Strings, String Matching.

Algorithm-Independent Machine Learning : No-Free Lunch Theorem, Bias and Variance, Resampling for Estimation, Bagging and Boosting, Estimation of Misclassification, Classifier Combination.

Unsupervised Learning and Clustering : Unsupervised Learning and Clustering.

Text and Reference Books:

[1] Pattern Classification (2nd. Edition) by R. O. Duda, P. E. Hart and D. Stork, Wiley 2002,

[2] Pattern Recognition and image analysis by Earl Gose, Richard Johnsobaugh, Steve Jost, EEE adition, PHR publication.

[3] Pattern Recognition and Machine Learning by C. Bishop, Springer 2006,

[4] Statistics and the Evaluation of Evidence for Forensic Scientists by C. Aitken and F. Taroni, Wiley, 2004.

Course Code .: CST505 -3 **Course : Advanced topics in networks**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Understand the main abstract concepts related to the layered communication architecture
2. Analyze and implement some of the most advanced routing and congestion control algorithms.
3. Evaluate the performances of computer networks (through mathematical modeling and simulation).
4. Understand basics and principles of new generation of computer networks (VPN, wireless networks, mobile networks...).
5. Practice network simulators

Course Syllabus:

Unit I

Routing and Internetworking:

Network–Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intradomain Routing Protocols, Interdomain Routing Protocols, Congestion Control at Network Layer. Logical Addressing: IPv4 Addresses, IPv6 Addresses -Internet Protocol: Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6 –Multicasting Techniques and Protocols: Basic Definitions and Techniques, Intradomain Multicast Protocols, Interdomain Multicast Protocols, Node-Level Multicast algorithms.

Unit II

Transport and End-to-End Protocols:

Mobile Transport Protocols, Mobile IP : Mobile IP, Wireless Mesh Networks (WMNs),TCP Congestion Control Application Layer: Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, Building a Simple Web Server.

Unit III

Non Blocking I/O,Client server design alternatives-TCP test client,TCP iterative server,TCp concurrent server one child per client TCP Prevoked Server No Locking Around accept, Prevoked Server File Locking Around accept, Prevoked Server Thread Locking Around accept. Streams.

Unit IV

Optical Networks and WDM Systems:

Overview of Optical Networks, Basic Optical Networking Devices, Large-Scale Optical Switches, Optical Routers, Wavelength Allocation in Networks, Case Study: An All-Optical Switch.

Unit V

VPNs, Tunneling and Overlay Networks: Virtual Private Networks (VPNs), Multiprotocol Label Switching (MPLS), Overlay Networks –VoIP and Multimedia Networking:Overview of IPTelephony, VoIP Signaling Protocols, Real-Time Media Transport Protocols, Distributed Multimedia Networking, Stream Control Transmission Protocol.

Unit VI

Mobile A-Hoc Networks: Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks Wireless Sensor Networks: Sensor Networks and Protocol Structures, Communication Energy Model, Clustering Protocols, Routing Protocols.

Text Books:

1. Computer Networking: A Top-Down Approach Featuring the Internet,James F. Kurose, Keith W.Ross, Third Edition, Pearson Education, 2007
2. Computer and Communication Networks, Nader F. Mir, Pearson Education, 2007.
3. Unix Network Programming The Socket networking API Volume 1.Third edition by W.Richard Stevens Bill Fenner and Andrew M. Rudoff.Pearson Education.

Reference Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Fourth Edition, Tata McGraw Hill, 2007
2. Guide to Networking Essentials, Greg Tomsho,Ed Tittel, David Johnson,Fifth Edition,Thomson.
3. An Engineering Approach to Computer Networking , S.Keshav, Pearson Education.
4. Campus Network Design Fundamentals, Diane Teare, Catherine Paquet, Pearson Education (CISCO Press).
5. Computer Networks, Andrew S. Tanenbaum, Fourth Edition, Prentice Hall.
6. The Internet and Its Protocols,A.Farrel,Elsevier.

II SEMESTER

Course Code .: CST506 | **Course : Compiling for High Performance Architecture**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week | **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1 Understand the compiling issues for various parallel architectures.
2 Understand dependence and its role in parallel execution of code.
3 Vectorize code containing nested loops
4 Understand code transformation techniques.
5 Understand fine grained and coarse grained parallelism.
6 Manage memory and scheduling for parallel machine.

Course Syllabus

Parallel and vector architectures. Compiling for scalar pipeline, compiling for vector pipeline, superscaler and VLIW processors, compiling for multiple issue processors,. Procesor parallelism, Bernstein's conditions.

The role of dependence. Dependence analysis: Concept of dependence, classification of dependences, dependence in loops, dependence distance, dependence direction, loop carried and loop independent dependences, level of loop carried dependence.

Simple dependence testing, vectorization and parallelization, Preliminary transformations required to make dependence testing more accurate Loop normalization, scalar data flow analysis, induction variable substitution, scalar renaming.

Concept of Granularity: Fine-Grained parallelism and Coarse- Grained parallelism. Enhancing Fine-Grained parallelism (useful in vector machines and Machines with instruction-level parallelism) using loop distribution. Use of loop interchange for vectorization, scalar and array renaming, use of loop skewing.

Enhancing Coarse-Grained parallelism(Required for machines with multiple processors): using privatization and scalar expansion, loop alignment, loop fusion, use of loop interchange for parallelization

Handling control Dependence: Types of branches. If conversion. Management of Memory Hierarchy: scalar register allocation and management of the cache memory hierarchy. Topics include scalar replacement, unroll-and-jam, loop alignment, cache blocking, and prefetching.

Scheduling for Superscalar and Parallel Machines Machines : List Scheduling. Software Pipelining. Work scheduling for parallel systems. Guided Self-Scheduling

Text and Reference Books:

1. Allen and Kennedy, Optimizing Compilers for Modern Architectures, Morgan-Kaufmann, Second Printing, 2005.
2. Banerjee, Dependence Analysis, Kluwer Academic Publishers.
3. Wolfe, High Performance Compilers for Parallel Computing, Addison-Wesley, 1996.
4. Wolfe, Optimizing Supercompilers for Supercomputers, MIT Press.
5. Zima and Chapman, Supercompilers for Parallel and Vector Computers, ACM Press

Course Code .: CSP506 **Course : Compiling for High Performance Architecture Lab**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Syllabus:

The instructor should design the practical such that the student should be able:

- To study and understand the advanced compiler techniques.
- To illustrate the knowledge base earned after studying this course.
- To develop the code for loop handling.
- To develop the code for the demonstration of dependences.

Course Code .: CST507 **Course : Advanced Digital Image Processing**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Understand the application of Edge detection algorithms in real life applications like image segmentation and extraction of ROI.
2. Understand applications of Morphological algorithms in real life problems, like image boundary extraction, Thinning, Thickening, Expand/enlarge objects in the image, and fill gaps or bays of insufficient width, shape detection etc.
3. Understand the application of image segmentation algorithms like region based segmentation, watershed segmentation, and Thresholding in computer vision and Image analysis.
4. Understand the representation of shapes and contours, Fourier descriptors, and texture in biomedical images.
5. Understand the applications of Image Registration in biomedical images and Satellite images.
6. Understand the applications of image data compression standards in image processing.
7. Understand various object recognition and classification algorithms like neural networks, Bayesian classifiers, K-nearest Neighbors and clustering.
8. Understand the Image transforms and their applications in Image analysis.
9. Understand video processing standards MPEG-2 and MPEG-4.

Course Syllabus

Edge Detection : Computing the gradient, Roberts, Prewitt, Sobel operators, Second derivative-Laplacian, Canny edge detector, Edge linking-Local processing, Hough transform.

Image Morphology : Dilation, Erosion, Opening, Closing, Boundary extraction, Region filling, Hit or Miss Transform, Thinning, Thickening, Skeletonization, Pruning.

Image Segmentation : Pixel-based methods: thresholds level adjustment, continuity-based methods:-multi-thresholding, morphological operations, edge-based segmentation, detection of regions of interest-thresholding and binarization, detection of isolated points and lines (Hough transform), edge detection, region growing, watershed algorithm. Discrete Image Transforms: Discrete cosine transforms, Karhunen-Loeve transform, Sine transforms, Walsh-Hadamard transform, Haar Transform.

Image Analysis of Shape and Texture : Representation of shapes and contours, shape factors,Fourier descriptors, fractional concavity, analysis of specularity, texture in biomedical images,models for the generation of texture, statistical analysis of texture, Law's measures of texture energy,fractal analysis, Fourier-domain analysis of texture, structural analysis of texture.

Image Registration : Geometric mappings, numerical methods and optimization in registration,Intensity based registration, Feature based registration, Initialization techniques, Multiresolution techniques, parametric deformable registration, non-parametric deformable registration, image matchmetrics in registration.

Image Coding and Data Compression: Considerations based on information theory, noiselesscoding theorem for binary transmission, lossy versus lossless compression, distortion measures and fidelity criteria, fundamental concepts of coding (direct source coding, Huffman coding, run-length coding, arithmetic coding, Lempel-Ziv coding, contour coding), the need for decorrelation: transform coding, interpolative coding, predictive coding, compression standards: the jbig standard, the jpeg standard and jpeg 2000.

Object Recognition and Classification: Patterns and pattern classes, Statistical Decision Making (Bayesian Classifiers), Non-Parametric Decision Making (Histogram based, k Nearest Neighbors), Clustering based methods (Agglomerative and Partitional), Neural Networks (Single and Multi layer perceptron, Back propagation algorithm).

Video Processing: Introduction to video signal processing, video processing standards, MPEG block diagram and data flow, MPEG-2 and MPEG-4 standards, motion estimation and compensation algorithms, block matching algorithms, video compression and decompression, interactive video techniques.

Text and Reference Books:

[1] William K Pratt, Digital Image Processing, John Wiley & Sons, 2001

[2] Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision,Brooks, 1999

[3] Gonzalez and Richard E Woods, Digital Image Processing, Addison-Wesley, 2000

[4] Anil K Jain, Fundamentals of Digital Image Processing, Prentice-Hall India, 2001.

[5] Earl Gose, Richard Johnsonbaugh and Steve Jost, Pattern Recognition and Image Analysis, Prentice-Hall India, 2002.

[6] R. O. Duda, P. E. Hart and D.G. Stork, Pattern Classification, Wiley–Interscience, 2000.

[7] Gerard Blanchet and Maurice Charbit, Digital Signal and Image Processing using MATLAB, ISTE,2006.

[8] Gonzalez, Steven Eddins and Richard E Woods, Digital Image Processing using MATLAB, Prentice-Hall, 2000

[9] Mark S. Nixon and Alberto S. Aguado, Feature Extraction and Image Processing, Academic Press,2008

[10] Journals:IEEE Transactions in Imaging Processing, IEEE Transactions in Computer Vision, Journal of Real-Time Image Processing, Signal, Image and Video Processing, International Journal of Signal Processing, Image Processing and Pattern Recognition, Journal of Visual Communication and Image Representation.

[11] Magazines: Machine Vision and Image Processing Technology

Course Code .: CSP-507 **Course : Advanced Digital Images Processing**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Syllabus :

The instructor should design the practical such that the student should be able:

To design and simulate the following exercises using MATLAB:

- Edge detection and linking
- Image morphological operators
- Image segmentation
- Shape and texture analysis
- Registration
- Coding and compression
- Object recognition
- Classification
- Motion estimation

Course Code .: CST508 **Course : Data Management Techniques**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 06**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Justify the evolution of database systems and the needs
2. Technically analyze various schemes and techniques to handle organized data.
3. Identify research contents in the database domains
4. understand how to read technical papers

Course Syllabus :

1. Data Models and DBMS Architecture
   i. What Goes Around Comes Around By Michael Stonebraker and Joseph M. Hellerstein
   i. Anatomy of a Database System By Joseph M. Hellerstein and Michael Stonebraker
2. Query Processing
   i. Introduction
   ii. Access Path Selection in a Relational Database Management System By P. Griffiths Selinger, M. M. Astrahan, D. D. Chamberlin, R. A. Lorie, and T. G. Price
   iii. R* Optimizer Validation and Performance Evaluation for Distributed Queries By Lothar F. Mackert and Guy M. Lohman
3. Data Storage and Access Methods
   i. Introduction
   ii. The R*-tree: An Efficient and Robust Access Method for Points and Rectangles By Norbert Beckmann, Hans-Peter Kriegel, Ralf Schneider, and Bernhard Seeger
   iii.Operating System Support for Database Management By Michael Stonebraker
   iv.The Five-Minute Rule Ten Years Later, and Other Computer Storage Rules of Thumb By Jim Gray and Goetz Graefe
   v.A Case for Redundant Arrays of Inexpensive Disks (RAID) By David A. Patterson, Garth Gibson, and Randy H. Katz
4. Transaction Management
   i. Introduction
   ii. Granularity of Locks and Degrees of Consistency in a Shared Data Base By Jim N. Gray, Raymond A. Lorie, Gianfranco R. Putzolu, and Irving L. Traiger
   iii. On Optimistic Methods for Concurrency Control By H. T. Kung and John T. Robinson
5. Extensibility
   i. Introduction

6. Database Evolution
   i. Introduction
   ii. Algorithms for Creating Indexes for Very Large Tables Without Quiescing Updates By C. Mohan and InderpalNarang
7. Data Warehousing
   i. Itroduction
   ii. An Overview of Data Warehousing and OLAP Technology By SurajitChaudhuri and UmeshwarDayal
   iii. Informix under CONTROL: Online Query Processing By Joseph M. Hellerstein, Ron Avnur, Vijayshankar Raman
8. Data Mining
   i. Introduction
   ii. Fast Algorithms for Mining Association Rules By RakeshAgrawal and RamakrishnanSrikant
   iii. Class room material
9. Web Services and Data Bases
   i. Introduction
   ii. Combining Systems and Databases: A Search Engine Retrospective By Eric A. Brewer
10. Stream-Based Data Management
    i. Introduction
    ii. Eddies: Continuously Adaptive Query Processing By Ron Avnur and Joseph M. Hellerstein

Reference Books:

1. Database Systems 4th Edition : Hellerstein and Stonebraker, MIT Press, (2004).

Course Code .: CST509 **Course : Cryptography**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Able to describe fundamental concepts of computer security with the help of symmetric & asymmetric cryptography.
2. Able to know the fundamental concepts of different digital signature schemes .
3. Able to identify the security weaknesses in different networking environment.
4. Able to identify the appropriate cryptography scheme & security mechanism for different computing environment and information systems.

Course Syllabus:

Classical Cryptography-The Shift Cipher, The Substitution Cipher, The Affine Cipher, Cryptanalysis-Cryptanalysis of the Affine Cipher, Cryptanalysis of the Substitution Cipher, Cryptanalysis of the Vigenere Cipher, Shannon's Theory.

Block Cipher and the Advanced Encryption Standard-Substitution –Permutation Networks, Linear Cryptanalysis, Differential Cryptanalysis, The Data Encryption Standard, The Advanced Encryption Standard, Modes of Operation ,Cryptography Hash Function- Hash Function and Data Integrity, Security of Hash Function ,Iterated Hash Functions, Message Authentication Codes.

The RSA Cryptosystem and Factoring Integers-Introduction to Public –key Cryptography, Number theory, The RSA Cryptosystem ,Other Attacks on RSA, The ELGamal Cryptosystem, Shanks' Algorithm, Finite Fields, Elliptic Curves over the Reals, Elliptical Curves Modulo a Prime, Signature Scheme –Digital Signature Algorithm.

Identification Scheme and Entity Attenuation-Challenge-and-Response in the Secret-key Setting, Challenge-and-Response in the Public key Setting, The Schnorr Identificataon Scheme, Key distribution-Diffie-Hellman Key, Predistribution, Unconditionally Secure key Predistribution, Key Agreement Scheme-Diffie-Hellman Key agreement, Public key infrastructure-PKI, Certificates, Trust Models.

Secret Sharing Schemes-The Shamir Threshold Scheme, Access Structure and General Secret key sharing, Information Rate and Construction of Efficient Schemes, Multicast Security and Copyright production-Multicast Security, Broadcast Encryption, Multicast Re-keying, Copyright Protection, Tracing Illegally Redistribution keys.

Text & Reference Books:

1. Cryptography Theory and Practice: Third Edition Douglas R. Stinson, Chapman & Hall/CRC, (2006).
2. Handbollk of Appliled Cryptography: Menges A. J., Oorschot P, Vanstone S. ACRC Press, 1997.
3. Cryptography and Network Security: Principles and Practices: William Stallings, Third Edition, Pearson Education, (2006).

4. Modern Cryptography–Theory and Practice: Wenbo Mao, Pearson Education, First Edition, (2006).
5. Security in Computing: Charles B. Pfleeger, Shari Lawrence Pfleeger, Fourth Edition, Pearson Education, 2007.
6. Cryptography and network security - 2nd edition - Behrouz A. Forouzan, Debdeep Mukhopadhyay.

Introduction to Cryptography with Coding Theory: Wade Trappe and Lawrence C. Washington, Second Edition, Pearson Education, (2007).

Course Code .: CST510 -1 (Elective – II) **Course : Machine Learning**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Understand a number of models for supervised, unsupervised, and reinforcement machine learning
2. Describe the strength and weakness of each of these models
3. Understand the mathematical background from Linear Algebra, Statistics, and Probability Theory used in these machine learning models
4. Implement efficient machine learning algorithms on a computer
5. Design test procedures in order to evaluate a model
6. Combine several models in order to gain better results
7. Make choices for a model for new machine learning tasks based on reasoned argument

Course syllabus:

Introduction, Types of Machine Learning, Supervised Learning, Regression and Classification, Linear discriminants, The Perceptron.

Multilayer perceptron, Back Propagation of Error, Multilayer perceptron in practice, Examples using MLP, Radial Basis functions and Splines, Interpolation and basis functions.

Support Vector Machine, Optimal separation, Kernels, Learning with trees, Using Decision Trees, Implementation of decision trees, Classification and Regression trees CART, Decision by committee: Ensemble Learning.

Probability and learning, Turning data into probabilities, Gaussian Mixture model and nearest neighborhood model, Unsupervised learning, K-means algorithm, Vector Quantization, Self-Organized feature map.

Dimensionality Reduction, Linear Discriminant analysis (LDA), Factor Analysis, Independent Component Analysis, Reinforcement Learning, Markov Chain Monte Carlo Methods, Graphical Methods.

Text Books:

1. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Chapman and Hall publications
2. Pattern Recognition and Machine Learning, Bishop, Christopher M., Springer
3. Machine learning: Drew Conway and John White,Oreille publications
4. Machine Learning, Tom M.Mitchell, McGraw Hill Publications

Course Code .:CST510-2 (Elective –II) **Course : Middleware Technologies in Web and Mobile Domain**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Implement applications using JDBC and RMI.
2. Implement Distributed Java programming using CORBA
3. Implement EJB component and
4. Apply knowledge and techniques for dynamic adaptation in Mobile services.
5. Apply problem solving approaches towards seamless connectivity and location management

Course Syllabus:

CORBA with Java: Review of Java concept like RMI, RMI API, and JDBC. Client/Server CORBAstyle, The object web: CORBA with Java.

Core CORBA / Java: Two types of Client/ Server invocations-static, dynamic. The static CORBA, first CORBA program, ORBlets with Applets, Dynamic CORBA-The portable count, the dynamic count multi count.

Java Bean Component Model: Events, properties, persistency, Intrespection of beans, CORBA

Beans EJBs and CORBA: Object transaction monitors CORBA OTM's, EJB and CORBA OTM's, EJB container frame work, Session and Entity Beans, The EJB client/server development Process.

Fundamentals & Emerging Technologies

Infrastructure Vs ad Hoc Wireless network : Mobility issues and solutions, Evolution of application models for pervasive computing and mobile middleware motivation. Name resolution and service discovery on the internet and in ad Hoc network, data Synchronization, Content based published subscribe in a mobile environment, proxy based adaptation for mobile computing, reflective middleware, Techniques for Dynamic adaptation of mobile services.

Requirements for mobile middleware and connectivity

Naming and discovery in mobile system, efficient data caching and consistency maintenance in wireless mobile system Seamless connectivity in infrastructure based network. Peer to Peer computing in mobile Ad Hoc network, impact of mobility on resource management in wireless network, seamless service access via resource replication.

Mobile middleware for location dependent service

An overview of the location management problems for mobile computing environment, location privacy protection in mobile wireless network ,location based service differentiation, location dependent database access, location dependent service accounting middleware for wearable computing as an application domain for service based on mobile middleware.

Text Books:

1. Client/Server programming with Java and CORBA Robert Orfali and Dan Harkey, John Wiley & Sons ,SPD 2nd Edition.
2. Java programming with CORBA 3rd Edition, G.Brose, A Vogel and K.Duddy, Wiley-dreamtech, India John wiley and sons.
3. Handbook of mobile Middleware (Auerbach Publication) by Paulo Bellavista,Antonio Corradi,

Reference Books:

1. Distributed Computing, Principles and applications, M.L.Liu, Pearson Education
2. Client/Server Survival Guide 3rd edition Robert Orfali Dan Harkey and Jeri Edwards, John Wiley & Sons
3. Client/Server Computing D T Dewire, TMH.
4. IBM Webspere Starter Kit Ron Ben Natan Ori Sasson, TMh, New Delhi

Course Code .: CST510-3 (Elective –II) **Course : Parallel algorithms**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Understand the concept of parallelization in terms of architecture and software,
2. Understand dependence concepts and some important techniques used in parallelization.
3. Analyze the matrix operation on different parallel architecture.
4. Understand sorting techniques on parallel architecture and exploring the inherent parallelism present in algorithms
5. Understand searching techniques on parallel architecture and exploring the inherent parallelism present in algorithms
6. Abilities to implement various parallel graph algorithms on SIMD and MIMD architecture

Course Syllabus:

Introduction to Parallel Algorithms :

Parallel Models (SIMD, MIMD, PRAMs); Performance Measures (Time, Processors, Space, Work); Interconnection Architectures. Divide and Conquer, Partitioning, Pipelining techniques

Dependence Concepts :

Basic introduction of dependence in single loop and double loop, index and iteration spaces and perfect loop nest , Balanced Trees, Pointer Jumping, Tree Contraction

Dense Matrix Algorithms :

Matrix vector Multiplication, Matrix multiplication

Sorting :

Hyper quick sort, Merge sort, odd even transposition, Enumeration sort(sorting on the CRCW model, CREW model and EREW model)

Searching and Selection :

Searching on a sorted sequence(EREW,CREW,CRCW), Searching on a random sequence (EREW, CREW, CRCW, Tree and Mesh), Sequential selection algorithm, Parallel selection algorithm(EREW parallel solution)

Graphs Algorithms :

Connected Components, Spanning Trees, Shortest Paths

Text and Reference Books :

1. Introduction to Parallel Computing: AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar, Addison Wesley, Second edition.
2. The Design and Analysis of Parallel Algorithms :S.G.Akl, PHI, 1989.
3. Dependence Concept by Utpal Banerjee (Intel Corporation) Kluwer Academic Publishers

Course Code .: CSP511 **Course : Seminar**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 02**

Course Syllabus :

The students have to deliver the seminar on the recent happenings in the research domain and IT industry. They can formulate the project problem around the identified theme. Seminar presentation will be followed by the report submission.

III SEMESTER

Course Code .: CST602-4 (Elective –III) **Course : Big Data Analytics**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will:

1. Understand issues related to real-world data mining.
2. Understand the analysis process.
3. Have hands-on experience with analyzing diverse data types, using modern statistical computer tools.
4. Gain experience on recent topics in data mining.

Course Syllabus :

Introduction to Big Data Analytics : Big Data Overview, State of the Practice in Analytics, Data Analytics Lifecycle, data analytics problems.

Getting Ready to Use R and Hadoop : R installation, features and data modeling, Hadoop installation, features, and components, HDFS and MapReduce architecture

Writing Hadoop MapReduce Programs : basics of MapReduce, Hadoop MapReduce fundamentals, Writing a Hadoop MapReduce program, different ways to write Hadoop MapReduce in R.

Integrating R and Hadoop : introduction to RHIPE, architecture of RHIPE, RHIPE function reference, introduction to RHadoop, architecture of RHadoop, RHadoop function reference.

Using Hadoop Streaming with R : basics of Hadoop streaming, how to run Hadoop streaming with R, HadoopStreaming R package

Data Analytics using R and Hadoop : sample case study like web pages categorization.

Operationalizing an Analytics Project, Creating the Final Deliverables, Data Visualization Techniques.

Text and Reference Books :

1. Big Data Analytics with R and Hadoop by VigneshPrajapati, PACKT Publishing.
2. Big Data Analytics by Loshin, David, Morgan Kaufmann Publishers.
3. Using R to Unlock the Value of Big Data: Big Data Analytics by Tom Plunkett, Mcgraw-Hill.
4. Big Data Analytics : Turning Big Data into Big Money by Frank J. Ohlhorst, Wiley Publication.

Course Code .: CST602-5 (Elective –III) **Course : Advanced topics in Security**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Able to describe fundamental concepts of computer security .
2. Able to identify the security weaknesses in different networking environment.
3. Able to identify the appropriate schemes & security mechanism for different computing environment and information systems.

Course Syllabus :

Introduction and preliminaries, Cryptographic protocols, Protocol Building Blocks- Communication using symmetric cryptography, One-way functions, One-way Hash functions, Communications using Public key cryptography, Digital signatures with encryption, Random and pseudo-random sequence generation, Basic protocols- Authentication and key exchange, Formal analysis of authentication and key exchange protocols, Multiple- key Public-key cryptography, Secret splitting, Secret sharing, cryptographic protection of databases.

Intermediate protocols - Time stamping services, Subliminal channel, Undeniable digital signatures, Designated Confirmer signatures, Proxy signatures, Group signatures, Fail-stop digital signatures, Computing with encrypted data, Bit Commitment, Fair coin flips, Mental Poker, One-way accumulators, All-or-nothing disclosure of secrets, Key escrow, Advanced protocols- Zero-knowledge proofs, Blind

Signatures, Identity-Based public-key cryptography, Oblivious transfer, Oblivious signatures, Simultaneous contract signing, Digital certified mail, Simultaneous exchange of secrets. Esoteric protocols- Secure elections, Secure multiparty computation, Anonymous message broadcast, Digital cash.

Cryptographic techniques- Key Length- Symmetric key length, Public-key key length, Birthday attacks against One-Way Hash functions, Caveat Emptor, Key Management- Generating keys, Nonlinear keyspaces, Transferring ,Verifying, Using, Updating and Storing keys, Backup Keys, Compromised keys, Lifetime of keys, Destroying keys, Public-key management.

Algorithms types and Modes- Electronic Codebook mode, Block replay, Cipher block chaining mode, Stream ciphers - Self-synchronizing, Cipher feedback mode, Synchronous ciphers, Output feedback mode, Counter mode, Other block-cipher modes, Choosing a cipher mode, Interleaving, Choosing an algorithm, Public key cryptography versus Symmetric cryptography, Encrypting communication channels, Encrypting data for storage, Hardware versus software encryption.

Cryptographic algorithms- Information theory, Complexity theory, Number theory, Data Encryption

and Standard-Description, Security, Differential and Linear cryptanalysis, DES variants, Block Ciphers- Lucifer, NewDES, FEAL,RC2, IDEA, MMB, Other Block algorithms, Theory of Block Cipher Design, Using One-Way Hash functions, Choosing a block algorithm, One-Way Hash Functions- MD2, MD4,MD5,

SHA,HAVAL, Using symmetric key algorithms, Using public key algorithms, Knapsack, RSA, DSA, Secretsharing algorithms.

Text Books :

[1] Applied Cryptography: Protocols, Algorithms and Source code in C- Bruce Schneieir, John Wiley & Sons, Edition, 1996

[2] Cryptography A Primer- Alan G Konhein, John Wiley & sons, 1981

[3] Handbook of Applied Cryptography- Alfred Menezes, Paul van Oorschot, Scott Vanstone, CRC Press, Edition 1, 1996

Reference Books:

[1] Introduction to Modern Cryptography- Jonathan Katz, Yehuda Lindell, Chapman and Hall/CRC; Edition 1, 2007

[2] Understanding Cryptography- Chritof Paar, Jan Pelzl, Bart Preneel, Springer; Edition 2 2010

[3] Cryptography: A New Dimension in Computer Data Security- Carl Meyer, SM Matyas, John Wile &Sons, 1982

Course Code .: CST 602-6 (Elective III) **Course : Social Network Analysis**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Understand social networks, its architecture & significance
2. Understand Network centrality
3. Analyze Cliques and Sub-groups within social Networks.
4. Understand Automorphic Equivalence
5. Apply concepts on Small world network models and to study various models.

Course Syllabus:

Unit I

Social network data: Introduction & What's different about social network data? Nodes, boundaries, Modality Relations , Sampling ties, Multiple, Scales. Why formal methods? Using graphs to represent social relations. Using matrices to represent social relations. Connection and distance ,Networks and actors ,exchange, Connection ,demographics, Density,Reachability,Connectivity,Distance ,Walks etc., diameter, Flow.

Unit II

Network centrality: Density,Reciprocity,Transitivity,Clustering,Krackhardt's Graph Theoretical Dimensions of Hierarchy. Ego networks, Centrality and power, Degree centrality Degree: Freeman's approach, Closeness, Betweenness Centrality

Unit III

Cliques and Sub-groups: Groups and sub-structures, Bottom-up approaches ,Top-down approaches ,Defining equivalence or similarity ,Structural equivalence, Automorphic, Regular equivalence ,Measures of similarity and structural equivalence

Unit IV

Measuring similarity/dissimilarity :Pearson correlations covariance's and cross-products, distances, Binary , Matches: Exact , Jaccard , Hamming, Visualizing similarity and distance ,Describing structural equivalence sets :Clustering similarities or distances profiles, CONCOR

Unit V

Automorphic Equivalence: Defining automorphic equivalence, Uses of the concept, Finding equivalence Sets, All permutations (i.e. brute force), Optimization by tabu search, Equivalence of distances: Maxsim

Unit VI

Small world network models, optimization, strategic network formation and search

Concepts: small worlds, geographic networks, decentralized search, Contagion, opinion formation, coordination and cooperation, SNA and online social networks

Text Books:

1. Hanneman, Robert A. and Mark Riddle. 2005. Introduction to social network methods. Riverside, CA: University of California
2. Stanley Wasserman and Katherine Faust; Social Network Analysis - Methods & Applications ; Cambridge Univ. press; 1998.
3. John Scott ; Social Network Analysis - A Handbook; Second Edition ; SAGE Publication; 2000.

Reference Books :

1. Charu Agrawal; Social Network Data Analytics ; Springer; 2011.
2. Wouter Nooy, Andrei Movar and Vladimir Batagelj; Exploratory Social Network Analysis with Pajek; Cambridge Univ. press; 2005.

Course Code .: CST602-7 (Elective –III) **Course : Biometrics**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 08**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Analyze the basic engineering principles underlying biometric systems
2. Understand and analyze biometric systems and be able to analyze and design basic biometric system application
3. Identify all the leading applications of biometric systems
4. Identify the sociological issues associated with the design and implementation of biometric systems

Course Syllabus :

Biometric fundamentals – Biometric technologies – Biometrics Vs traditional techniques – Characteristics of a good biometric system – Benefits of biometrics – Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems: FAR, FRR, FTE rate, EER and ATV rate.

Leading technologies : Finger-scan – Facial-scan – Iris-scan – Voice-scan – components, working principles, competing technologies, strengths and weaknesses – Other physiological biometrics : Hand-scan, Retina-scan – components, working principles, competing technologies, strengths and weaknesses – Automated fingerprint identification systems.

Leading technologies: Signature-scan – Keystroke scan – components, working principles, strengths and weaknesses.

Categorizing biometric applications – application areas: criminal and citizen identification, surveillance, PC/network access, e-commerce and retail/ATM – costs to deploy – other issues in deployment

Assessing the Privacy Risks of Biometrics – Designing Privacy-Sympathetic Biometric Systems – Need for standards – different biometric standards.

Text & Reference Books:

[1] Samir Nanavati, Michael Thieme, Raj Nanavati, "Biometrics – Identity Verification in a Networked World", Wiley-dreamtech India Pvt Ltd, New Delhi, 2003

[2] Paul Reid, "Biometrics for Network Security", Pearson Education, New Delhi, 2004

[3] John R Vacca, "Biometric Technologies and Verification Systems", Elsevier Inc, 2007

[4] Anil K Jain, Patrick Flynn, Arun A Ross, "Handbook of Biometrics", Springer, 2008

Course Code .: CST603-4 (Elective –IV) **Course : Reconfigurable and Cloud Computing**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 06**

Course outcomes:

On successful completion of the course, students will be able to:

1. Explores the relationship of cloud computing to other distributed computing paradigms, namely peer-to-peer, grids, high performance computing and web services
2. Presents the principles, techniques, protocols and algorithms that can be adapted from other distributed computing paradigms to the development of successful clouds
3. Examines cloud-practices and applications, and highlights early deployment experiences
4. Elaborates the economic schemes needed for clouds to become viable business models
5. Understanding about the cloud security and privacy concepts and implementation strategies.
6. Understand and explore various cloud service providers, facilities provided, costing involved etc.

Course Syllabus:

Cloud Base Tools and Technologies for Building Clouds A Taxonomy, Survey and Issues of Cloud Computing Ecosystems Towards a Taxonomy for Cloud Computing from an e-Science Perspective Examining Cloud Computing from the Perspective of Grid and Computer-Supported Cooperative Work Overview of Cloud Standards

Cloud Seeding Open and Interoperable Clouds : the Cloud@HomeWay A Peer-to-Peer Framework for Supporting MapReduce Applications in Dynamic Cloud Environments Enhanced Network Support for Scalable Computing Clouds YML-PC : A Reference Architecture Based on Workflow for Building Scientific Private Clouds An Efficient Framework for Running Applications on Clusters, Grids and Clouds Resource Management for Hybrid Grid and Cloud Computing Peer-to-Peer Cloud Provisioning: Service Discovery and Load-Balancing Mixing Grids and Clouds: High-throughput Science using the Nimrod Tool Family

Security Management in the Cloud : Security Management Standards, Security Management in the Cloud, Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management, Access Control, Security Vulnerability, Patch, and Configuration Management

Privacy What Is Privacy? What Is the Data Life Cycle? What Are the Key Privacy Concerns in the Cloud? Who Is Responsible for Protecting Privacy? Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing Legal and Regulatory Implications U.S. Laws and Regulations International Laws and Regulations

Examples of Cloud Service Providers Amazon Web Services (IaaS) Google (SaaS, PaaS) Microsoft Azure Services Platform (PaaS) Proofpoint (SaaS, IaaS) RightScale (IaaS) Salesforce.com (SaaS, PaaS) Sun Open Cloud Platform Workday (SaaS)

Text Books :

1. Cloud Computing: Principles, Systems and Applications, Antonopoulos, Nikos, Gillam, Lee (Eds.), Springer
2. Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance By Tim Mather, SubraKumaraswamy, ShahedLatif Publisher: O'Reilly Media
3. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, ZaighamMahmood, Ricardo Puttini

Course Code .: CST603-2 (Elective –IV) **Course : Wireless Sensor Network**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 06**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Apply knowledge of wireless sensor networks to various application areas.
2. Apply Wireless technology for distributed sensor networks.
3. Design, implement and maintain wireless sensor networks.
4. Understand Network support and management
5. Formulate and solve problems creatively.

Course Syllabus:

Unit I:

Application and design Model

Examples of available Sensor nodes, Sample sensor network Application Design challenges. Single node architecture and Network architecture: Design principles for WSNs, Service interfaces of WSNs, gateway concepts.

Unit II

Communication Protocol:

Mac Protocol: Fundamentals,Low duty cycle protocols and wakeup concepts,contention-based , schedule-based protocols. The IEEE 802.15.4 MAC protocol,IEEE 802.11 and Bluetooth. Naming and addressing: address and name management in wireless sensor network, Distributed assignment of locally unique addresses, content-based and Geographic addressing.

Unit III

Time Synchronization problems, Protocols based on sender/receiver synchronization:

Protocols based on receiver / receiver synchronization: Reference broadcast synchronization (RBS), Hierarchy referencing time synchronization (HRTS).

Unit IV

Localization and positioning and Topology control : properties of Localization and positioning, possible approaches: proximity, trilateration and triangulation. Mathematical basics for the lateration problem: solution with three anchors and correct distance values ,Hierarchical networks by clustering ,Adaptive Node activity: Geographic adaptive Fidelity(GAF).

Unit V

Routing Protocols and Data centric Networking:

Gossiping and agent based unicast forwarding, broadcast and multicast :source based tree protocol, Geographic Routing,Data centric routing and data aggregation : A database interface to describe aggregation operation.

Unit VI

Advanced application support:

Advanced in-network processing, Security challenges, treats and attack models, application specific support : Target detection and tracking, contour/edge detection.

Reference books:

1. Protocols and architectures for Wireless Sensor Networks (WSE Wiley) by Holger Karl and Andreas Willing.
2. Wireless Sensor Networks:Cauligi S.Raghavendra, Krishna Sivalingam,Taieb M.Znati,Springer.ISBN:1-4020-7883,August 2005.

Course Code .: CST603-5 (Elective –IV) **Course : Information Retrieval**

L:3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 06**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Understand issues in information retrieval and its evaluation parameters.
2. Understand organization of metadata for effective information access.
3. Understand, analyze and design scoring mechanisms.
4. Understand, analyze and formulate different language models.
5. Understand and design search engines.

Course Syllabus:

Unit I

Boolean retrieval, The term vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction, Index compression.

Unit II

Scoring, Term weighting and the vector space model Computing scores in a complete search system, Evaluation in information retrieval.

Unit III

Relevance feedback and query expansion, XML retrieval, Probabilistic information retrieval

Unit IV

Language models for information retrieval, Text classification and Naive Bayes, Vector space classification, Support vector machines and machine learning on documents.

Unit V

Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing,

Unit VI

Web search basics, Web crawling and indexes, Link analysis

Text Books:

1. An Introduction to Information Retrieval: Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, Cambridge University Press.

Reference Books:

1. Speech and Language Processing : Jurafsky Dan and Martin James, Pearson Publication.
2. Natural Language Understanding : Allen James , Pearson Publication.

Course Code .: CST603-6 (Elective IV) **Course : Ubiquitous Computing**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 06**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Understand the basic concepts of Ubiquitous computing.
2. Understand the concept of wireless LANs, Mobile Networks, and Sensor Networks
3. Recognize the research issues in ubiquitous computing.
4. Understand applications and requirements of ubiquitous computing.
5. Describe the important issues and concerns on security and privacy in ubiquitous computing.
6. Understand the applications of Human Computer interaction.
7. Understand the applications of smart devices and services.

Course Syllabus

Ubiquitous Computing : Basics and Vision: Living in a Digital World, Illustrative Ubiquitous Computing Applications, Modelling the Key Ubiquitous Computing Properties, Core Properties of UbiCom Systems, Implicit Human Computer Interaction (iHCI), Context Awareness, Reducing Human Interaction, Easing System Maintenance Versus Self Maintaining Systems, Architectural Design for UbiCom Systems: Smart DEI Model, Smart Devices, Smart Environments, and Smart Interaction.

Applications and Requirements : Introduction, Example Early UbiCom Research Projects, Smart Devices: CCI, Smart Environments: CPI and CCI, Smart Devices: CPI, Everyday Applications in the Virtual, Human and Physical World, Ubiquitous Networks of Devices: CCI, Human Computer Interaction, Human to Human Interaction (HHI) Applications, Transaction based M Commerce and U Commerce Services, Smart Utilities, Smart Buildings and Home Automation, Smart Living Environments and Smart Furniture.

Smart Devices and Services : Introduction, Smart Device and Service Characteristics, Distributed System Viewpoints, Abstraction versus Virtualisation, Service Architecture Models, Partitioning and Distribution of Service Components ,Multi tier Client Service Model, Distributed Data Storage, Distributed Processing ,Client Server Design 83,Proxy based Service Access, Middleware, Service Oriented Computing (SOC) Grid Computing, Peer to Peer Systems, Device Models ,Service Provision Life Cycle, Network Discovery, Web Service Discovery, Virtual Machines and Operating Systems, Virtual Machines, BIOS.

Smart Mobiles, Cards and Device Networks : Introduction ,Smart Mobile Devices, Users, Resources and Code, Operating Systems for Mobile Computers and Communicator Devices, Microkernel Designs ,Mobility Support ,Resource Constrained Devices, Power Management ,Smart Card Devices ,Smart Card OS ,Smart Card Development , Device Networks.

Human–Computer Interaction : Introduction, Explicit HCI: Motivation and Characteristics, Complexity of Ubiquitous Explicit HCI, Implicit HCI: Motivation and Characteristics, User Interfaces and Interaction for Four Widely Used Devices, Diversity of ICT Device Interaction, Personal Computer Interface, Mobile Hand Held Device Interfaces, Hidden UI Via Basic Smart Devices Multi Modal Visual Interfaces, Gesture Interfaces, Touchscreens, Natural Language Interfaces, Human Centred Design (HCD).

Tagging, Sensing and Controlling

Tagging the Physical World, Life Cycle for Tagging Physical Objects, Tags: Types and Characteristics, Physical and Virtual Tag Management, RFID Tags, Active RFID Tags, Passive RFID Tags, Sensors and Sensor Networks, Micro Actuation and Sensing: MEMS, Embedded Systems and Real Time Systems, Robots, Robot Manipulators, Nanobots.

Text Book:

1. Ubiquitous Computing: Smart Devices, Environments and Interactions Stefan Poslad, John Wiley and Sons, Ltd, Publication

Course Code .: CST603 | **Course : Research Methodology**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week | **Total Credits : 06**

Course Outcomes :

1. Ability to critically evaluate current research and propose possible alternate directions for further work
2. Ability to develop hypothesis and methodology for research
3. Ability to comprehend and deal with complex research issues in order to communicate their scientific results clearly for peer review.

Course Syllabus:

Introduction to research methodology

Meaning of Research, Objectives of Research, Motivation in Research, Types ofResearch, Research Approaches, Significance of Research, research Methods versusMethodology, Research and Scientific Method, Research Process, Criteria of good Research, Necessity and Techniques of Defining the Problem, Meaning and need of Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Design, Research ethics, Stress management

Literature review, Data collection and sampling design

Review concepts and theory, review previous findings, Sources of data: Primary and secondary data, Methods of data collection, Sampling fundamentals

Modeling and Analysis

Probability distributions, Processing and analysis of data, Data analysis skills, Distributions, Statistical and multivariate analysis, Correlation and regression, Fundamentals of Time series analysis, spectral analysis, Error analysis, Simulation techniques

Algorithmic processes in Computer science research domains

Soft computing, Artificial intelligence, NLP, Image processing, Data management techniques, Networks and security, Software systems

Research reports

Structure and components of Research report, Types of report, Layout of research report, Mechanisms and tools for writing research report, LaTeX

Text Book

1. C.R. Kothari, Research Methodology Methods and Techniques, 2ndRevised edition, New Age

Reference Books

1. Richard I Levin amp; David S.Rubin, Statistics for Management, 7/e. Pearson Education, 2005.
2. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.
3. Bendat and Piersol, Random data: Analysis and Measurement Procedures, Wiley Interscience, 2001.
4. Shumway and Stoffer, Time Series Analysis and its Applications, Springer, 2000.
5. Jenkins, G.M., and Watts, D.G., Spectral Analysis and its Applications, Holden Day, 1986.

Course Code .: CST604 **Course : Project Phase -I**

L: 0 Hrs., T: 0 Hrs., P: 6 Hrs., Per week **Total Credits : 24**

Project Phase-1:

In this phase, student has to go for two seminars:

Progress Seminar-1: Based on Literature Review & Problem Definition.

Progress Seminar-2: Based on Partial Implementation & Preliminary Results.

IV SEMESTER

Course Code .: CST605 | **Course : Project Phase -II**

L: 0 Hrs., T: 0 Hrs., P: 12 Hrs., Per week | **Total Credits : 48**

Project Phase-2:

In this phase, student has to go for:

Progress Seminar-1: Based on the progress done in the implementation and results obtained.

Progress Seminar-2: Based on the Complete Implementation and Results analysis.

Demonstration followed by Report Submission.