

# **SCHEME OF EXAMINATION**

**&**

**SYLLABI**

**for**

**B. TECH.COMPUTER SCIENCE & ENGINEERING**

**YEAR FOURTH**

**(Effective from the session: 2009-2010)**



**Uttarakhand Technical University, Dehradun**

*[www.uktech.in](http://www.uktech.in)*

**UTTRAKHAND TECHNICAL UNIVERSITY, DEHRADUN**  
**STUDY AND EVALUATION SCHEME**  
**B. TECH.COMPUTER SCIENCE & ENGINEERING**  
**YEAR FOURTH, SEMESTER - VII**  
**(Effective from the session: 2009-2010)**

S.No	Course Code	Subject	PERIODS			EVALUATION SCHEME				Subject Total
						SESSIONAL EXAM			EXAM ESE	
			L	T	P	CT	TA	Total		
1	TCS-701	Introduction to Web Technology	3	1	0	30	20	50	100	150
2	TCS- 702	Advanced Computer Architecture	3	1	0	30	20	50	100	150
3		Elective I	3	1	0	30	20	50	100	150
4		Elective-II	3	1	0	30	20	50	100	150
5		Open Elective	3	1	0	30	20	50	100	150
<b>Practical/Training/Project</b>										
1	PIT-751	Web Technology Lab	0	0	2	-	25	25	25	50
2	PIT-752	Advanced Computer Architecture Lab	0	0	2	-	25	25	25	50
3	PIT-753	Colloquium & Industrial Report	0	0	2	-	50	50	-	50
4	PIT-754	Project	0	0	2	-	25	25	25	50
5	GP-701	General Proficiency	-	-	-	-	50	50	-	50
<b>Total</b>			<b>15</b>	<b>5</b>	<b>8</b>					<b>1000</b>

**Choose one Subject from each Elective**

Code	Elective I	Code	Elective II
CS – 011	Digital Image Processing	CS- 021	Cryptography & Network Security
CS – 012	Network Programming & Administration	CS 022	.Net Technologies & Visual Programming
CS – 013	Real Time System	CS 023	System Software and Administration
CS –014	Wireless Networks	CS 024	Soft Computing

**UTTRAKHAND TECHNICAL UNIVERSITY, DEHRADUN**  
**STUDY AND EVALUATION SCHEME**  
**B. TECH.COMPUTER SCIENCE & ENGINEERING**  
**YEAR FOURTH, SEMESTER - VIII**  
**(Effective from the session : 2009-2010)**

S.No	Course Code	Subject	PERIOD S			EVALUATION SCHEME				Subject Total
						SESSIONAL EXAM			EXAM ESE	
			L	T	P	CT	TA	Total		
1	TCS-801	Distributed Systems	3	1	0	30	20	50	100	150
2	TCS 802	Mobile Computing	3	1	0	30	20	50	100	150
3		Elective-III	3	1	0	30	20	50	100	150
4		Elective-IV	3	1	0	30	20	50	100	150
<b>Practical/Training/Project</b>										
1	PCS-851	Distributed Systems Lab	0	0	2	-	25	25	25	50
2	PCS-852	Project	0	0	2	-	100	100	200	300
3	GP-801	General Proficiency	-	-	-	-	50	50	-	50
<b>Total</b>			<b>12</b>	<b>4</b>	<b>4</b>					<b>1000</b>

**Choose one subject from each elective**

Code	Elective II	Code	Elective III
CS – 031	Embedded Systems	CS – 041	Advanced DBMS
CS - 032	Parallel Computing	CS – 042	Data Mining & Data Warehousing
CS – 033	Multimedia Communication & System Design	CS – 043	Computational Geometry
CS – 034	Pattern Recognition	CS – 044	Granular Computing
CS-035	Natural Language Processing	CS-045	Storage Networks

## **(TCS-701) INTRODUCTION TO WEB TECHNOLOGY**

### **UNIT I: Introduction and Web Development Strategies**

History of Web, Protocols governing Web, Creating Websites for individual and Corporate World, Cyber Laws, Web Applications, Writing Web Projects, Identification of Objects, Target Users, Web Team, Planning and Process Development.

### **UNIT II: HTML, XML and Scripting**

List, Tables, Images, Forms, Frames, CSS Document type definition, XML schemes, Object Models, Presenting XML, Using XML Processors: DOM and SAX, Introduction to Java Script, Object in Java Script, Dynamic HTML with Java Script.

### **UNIT III: Java Beans and Web Servers**

Introduction to Java Beans, Advantage, Properties, JDK, Introduction to EJB, Java Beans API Introduction to Servlets, Lifecycle, JSDK, Servlet API, Servlet Packages: HTTP package, Working with Http request and response, Security Issues.

### **UNIT IV: JSP**

Introduction to JSP, JSP processing, JSP Application Design, Tomcat Server, Implicit JSP objects, Conditional Processing, Declaring variables and methods, Error Handling and Debugging, Sharing data between JSP pages- Sharing Session and Application Data.

### **UNIT V: Database Connectivity**

Database Programming using JDBC, Studying Javax.sql.\*package, accessing a database from a JSP page, Application-specific Database Action, Developing Java Beans in a JSP page, introduction to Struts framework.

### **Books:**

1. Burdman, "Collaborative Web Development" Addison Wesley.
2. Chris Bates, "Web Programming Building Internet Applications", 2nd Edition, WILEY, Dreamtech
3. Joel Sklar , "Principal of web Design" Vikash and Thomas Learning
4. Horstmann, "CoreJava", Addison Wesley.
5. Herbert Schildt, "The Complete Reference:Java", TMH.
6. Hans Bergsten, "Java Server Pages", SPD O'Reilly

## **(TCS - 702) ADVANCE COMPUTER ARCHITECTURE**

### **Unit-I: Introduction**

Introduction to parallel computing, need for parallel computing, parallel architectural classification schemes, Flynn's , Fengs classification, performance of parallel processors, distributed processing, processor and memory hierarchy, bus, cache & shared memory, introduction to super scalar architectures, quantitative evaluation of performance gain using memory, cache miss/hits.

## **Unit-II: Multi-core Architectures**

Introduction to multi-core architectures, issues involved into writing code for multi-core architectures, development of programs for these architectures, program optimizations techniques, building of some of these techniques in compilers, OpenMP and other message passing libraries, threads, mutex etc.

## **Unit-III: Multi-threaded Architectures**

Parallel computers, Instruction level parallelism (ILP) vs. thread level parallelism (TLP), Performance issues: Brief introduction to cache hierarchy and communication latency, Shared memory multiprocessors, General architectures and the problem of cache coherence, Synchronization primitives: Atomic primitives; locks: TTS, ticket, array;

Barriers: central and tree; performance implications in shared memory programs; Chip multiprocessors: Why CMP (Moore's law, wire delay); shared L2 vs. tiled CMP; core complexity; power/performance; Snoopy coherence: invalidate vs. update, MSI, MESI, MOESI, MOSI; performance trade-offs; pipelined snoopy bus design; Memory consistency models: SC, PC, TSO, PSO, WO/WC, RC; Chip multiprocessor case studies: Intel Montecito and dual-core, Pentium4, IBM Power4, Sun Niagara

## **Unit-IV: Compiler Optimization Issues**

Introduction to optimization, overview of parallelization; Shared memory programming, introduction to OpenMP; Dataflow analysis, pointer analysis, alias analysis; Data dependence analysis, solving data dependence equations (integer linear programming problem); Loop optimizations; Memory hierarchy issues in code optimization.

## **Unit-V: Operating System Issues and Applications**

Operating System issues for multiprocessing Need for pre-emptive OS; Scheduling Techniques, Usual OS scheduling techniques, Threads, Distributed scheduler, Multiprocessor scheduling, Gang scheduling; Communication between processes, Message boxes, Shared memory; Sharing issues and Synchronization, Sharing memory and other structures, Sharing I/O devices, Distributed Semaphores, monitors, spin-locks, Implementation techniques on multi-cores; OpenMP, MPI and case studies Case studies from Applications: Digital Signal Processing, Image processing, Speech processing.

### **Books:**

1. Hwang, "Advanced Computer Architecture", New Age International
2. Quin, "Parallel Computing, Theory & Practices", McGraw Hill
3. M. Morris Mano, "Computer System Architecture", PHI
4. Richard Y. Kain, "Advanced Computer Architecture: A System Design Approach", PHI

## (CS - 011 ) DIGITAL IMAGE PROCESSING

### **UNIT-I Introduction and Fundamentals**

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

### **Image Enhancement in Spatial Domain**

Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

### **UNIT-II**

#### **Image Enhancement in Frequency Domain**

Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.

#### **Image Restoration**

A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only- Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

### **UNIT-III**

#### **Color Image Processing**

Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation.

#### **Morphological Image Processing**

Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

### **UNIT-IV**

#### **Registration**

Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth

#### **Segmentation**

Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge

Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

## **UNIT-V**

### **Feature Extraction**

Representation, Topological Attributes, Geometric Attributes

### **Description**

Boundary-based Description, Region-based Description, Relationship.

### **Object Recognition**

Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

### **Books:**

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: PHI.
2. B. Chanda, D.D. Majumder, "Digital Image Processing & Analysis", PHI
3. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.
4. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ.

## **(TCS – 012 )Network Programming & Administration**

### **Unit – I**

Introduction to Systems Programming: Files, System Files, File Formats, Buffered I/O, Directories, File System, Inodes, links,fcntl, links, locks, Device I/O, Terminal I/O, ioctl(), Files and Devices ,Signals, video I/O ,Multi-Tasking

### **Unit - II**

Processes and Inter-Process Communication: timers, polling vs interrupts, environment, fork, exec, wait, environment, exit and wait, pipe, fifos, message queues, semaphore

### **Unit - III**

Network Programming: Sockets, Operation, Socket types, Domains Name Binding, Closing Sockets, I/O Multiplexing, Client/Server Models, Connection Based Services, Handling Out of Band Data, Connectionless Services, Design issues of Concurrent and iterative servers, Socket options

### **Unit - IV**

XDR and Remote Procedure Calls, Network Programming at the level of Programming Language (can use Java or Python as case study)

**Text Book:**

1. Unix Network Programming, W. Richard Stevens, Prentice Hall, 1998

**References:**

1. Internetworking with TCP/IP, Volume3, Douglas Comer, Prentice Hall, 2000
2. Internetworking with TCP/IP, Volume1, Douglas Comer, Prentice Hall, 2000

**(CS - 013) REAL TIME SYSTEMS****UNIT-I: Introduction**

Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.

**UNIT-II: Real Time Scheduling**

Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

**UNIT-III: Resources Access Control**

Effect of Resource Contention and Resource Access Control (RAC), Nonpreemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority-Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects.

**UNIT-IV: Multiprocessor System Environment**

Multiprocessor and Distributed System Model, Multiprocessor Priority-Ceiling Protocol, Schedulability of Fixed-Priority End-to-End Periodic Tasks, Scheduling Algorithms for End-to-End Periodic Tasks, End-to-End Tasks in Heterogeneous Systems, Predictability and Validation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints.

**UNIT-V: Real Time Communication**

Model of Real Time Communication, Priority-Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, Communication in Multicomputer System, An Overview of Real Time Operating Systems.



**Books:**

1. Real Time Systems by Jane W. S. Liu, Pearson Education Publication.
2. Real-Time Systems: Scheduling, Analysis, and Verification by Prof. Albert M. K. Cheng, John Wiley and Sons Publications.

**(CS – 014 ) WIRELESS NETWORKS****Unit – 1 Introduction**

Liberalization of communications Industry, Digitalization of content, changes in spectrum management, cellular reuse, drive towards broadband, IEEE 802.11 networks

**Unit – 2 Wireless Network Systems****Cellular networks**

The GSM circuit switched network, GSM channel structure, Authentication and location updating, physical channels, TMN

**GPRS**

Introduction to GPRS, contexts, PDP context, Mobility management context, MS-SGSN physical layer, MS-SGSN protocols, GPRS operations

**Unit – 3 Principles of access network planning****Circuit voice networks**

Introduction to CVN, coverage, capacity, planning for circuit multimedia services

**Planning for packet multimedia services**

Planning approaches, buffer-pipe model, characterization of applications, practical modeling methodologies, multiuser packet transport configurations

**Unit – 4 Planning and design**

RAN, GSM RAN, UMTS RAN, Cellular OFDM RAN, Mesh network

**Unit – 5 Network operation and optimization**

Enhanced telecom operations model (eTOM), wireless network life cycle – strategy, infrastructure and product, operations, enterprise management,

GSM network performance optimization – principles and key performance indicators, coverage optimization, GPRS RAN optimization, UMTS network performance optimization

**Text Books:**

1. Deploying Wireless networks, Andy wilton, Tim charity, Cambridge university press
2. Fundamental of Wireless Networking, Ron Price, TMH
3. 3G Wireless Networks, Clint Smity, TMH
4. Essentials of UMTS, Christopher Cox, Cambridge University Press

## (CS 021/TIT 701 ) CRYPTOGRAPHY AND NETWORK SECURITY

### **Unit-I**

Introduction to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers.

Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

### **Unit-II**

Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

### **Unit-III**

Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA).

Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

### **Unit-IV**

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

### **Unit-V**

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management.

Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET).

System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

**Books:**

1. William Stallings, “Cryptography and Network Security: Principals and Practice”, Prentice Hall, New Jersey.
2. Johannes A. Buchmann, “Introduction to Cryptography”, Springer-Verlag.
3. B. Forouzan, “Cryptography and Network Security, TMH

## **(CS 022) .Net Technologies & Visual Programming**

### **UNIT 1 The Philosophy of .NET**

Understanding the previous states affair, The .NET Solution, The building Block of the .NET platform (CLR,CTS,CLS), the role of the .NET base class libraries, What C# brings to the table, additional .NET – Aware programming Languages, An overview of .NET binaries (aka assemblies), The role of the common intermediate language, The role of .NET type metadata, The role of the assembly manifest, Compiling CIL to platform specific instruction, Understanding the common type system, Intrinsic CTS data types, Understanding the common languages specification, Understanding the common languages runtime, A tour of the .NET namespace, increasing your namespace nomenclature, Deploying the .NET runtime.

### **UNIT 2 Building C# Applications**

The role of the command line compiler (CSC.exe), Building C# application using csc.exe, Working with csc.exe response file, generating bug reports, Remaining C# compiler option, The command line debugger, using the visual studio. Net IDE, Other key aspects of the VS.Net IDE, Documenting your source code via XML, C# preprocessor directives, An interesting Aside: The System. Environment class, Building .Net application with other IDEs. C# Language Fundamentals : An Anatomy of a basic C# class, Creating objects: Constructor basic, the composition of a C# application, Default Assignment and variable scope, The C# member initialization syntax, Basic input and output with the console class, Understanding value types and reference types, The master node: System. Objects, The system Data type (And C# aliases), Converting between value type and reference type: Boxing and Unboxing, Defining program constraints, C# Iterations constructs, C# control flow constructs, The complete set C# operator, Defining Custom class methods, Understanding static methods, Method parameter modifiers, Array manipulation in C#, String manipulation in C#, C# Enumerations, Defining structures in C#, Defining custom namespaces.

### **UNIT 3 Object Oriented Programming with C#**

Formal definition of the C# class, Definition the “Default public interface” of a type, Recapping the pillars of OOP, The first pillar: C# Encapsulation services, Pseudo Encapsulation: Creating read only field, The second pillar: C#'s Inheritance supports keeping family secrets: The “Protected” keyword, The Nested type definitions, The third pillar: C#'s Polymorphic support casting between types, Generating class definitions using Visual Studio. Net. Exceptions and Objects Life Time Ode to errors, Bugs and exceptions, The role of .NET exceptions handling, The system. Exception base class throwing a generic exception catching exception, CLR system level exception (System. system exception),Custom application level exception (System. application exception), Handling multiple exception, The finally block, The last chance exception, dynamically identify application and system level exception,

Debugging system exception using VS.Net, Understanding Object life time, The CIT of new, The basic of garbage collection, Finalizing a type, Finalization process, building and Ad hoc destruction method, garbage collection optimization, The system .GC type.

#### **UNIT 4 Interfaces and Collections**

Defining interfaces using C#, Invoking interface member at the object level, Exercising the shape hierarchy, Understanding explicit interface implementation, Interfaces as Polymorphic agents, Building interface hierarchies, Implementing interface using VS.Net, Understanding the IConvertible interface, Building a custom enumerator (I Enumerable and IEnumerator), Building cloneable objects (Icloneable), Building comparable objects (I Comparable), Exploring the system the collection namespace, Building a custom container (Retrofitting the cars type).

#### **UNIT 5**

Understanding .Net Assembles Problems with classic COM Binaries, An overview of .Net assembly, Building a simple file test assembly, A C# Client Application, A Visual Basic .Net Client application, Cross Language Inheritance, Exploring the Carlibrary's manifest, Exploring the Carlibrary's Types, Building the multi file assembly, Using the multi file assembly, Understanding private assemblies, Probing for private assemblies (The Basics), Private assemblies and XML Configuration files, Probing for private assemblies (The Details), Understanding Shared assembly, Understanding Shared Names, Building a Shared assembly, Understanding delay Signing, Installing/Removing shared assemblies, Using a Shared assembly.

#### **Text Book:**

1. Andrew Troelsen C# and The .Net platform, , Second edition,2003, Dream TECH Press, India.
2. Tom Archer Inside C#, , 2001,WP Publishers.

### **(CS 023 ) System Software and Administration**

#### **Unit-I**

Assemblers: General design procedures, Design of two pass assemblers, Cross Assemblers, Macro Processors – Features of a macro facility,(macro instruction arguments, conditional macro expansion, macro calls within macros), Implementation of a restricted facility : A two pass algorithm; Macro Assemblers.

Loader schemes: Compile and go loaders, absolute loaders, relocating loader, Linking, Reallocation- static & dynamic linking, Direct linking loaders, Binders, Overlays, dynamic binders; Working principle of Editors, Debuggers.

System Administration

## **Unit- II**

**Introduction:** Duties of the Administrator, Administration tools, Overview of permissions.

Processes: Process status, Killing processes, process priority. Starting up and Shut down:

Peripherals, Kernel loading, Console, The scheduler, init and the inittab file, Run-levels, Run level scripts.

**Managing User Accounts:** Principles, password file, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users.

## **Unit - III**

**Managing Unix File Systems:** Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making filesystems, Superblock, I-nodes, Filesystem checker, Mounting filesystems, Logical Volumes, Network Filesystems, Boot disks

**Configuring the TCP/IP Networking :** Kernel Configuration; Mounting the /proc Filesystem, Installing the Binaries, Setting the Hostname, Assigning IP Addresses, Creating Subnets, Writing hosts and networks Files, Interface Configuration for IP, ifconfig, netstat command, Checking the ARP Tables; Name service and resolver configuration.

## **Unit- IV**

**TCP/IP Firewall :** Methods of Attack, What Is a Firewall? What Is IP Filtering? Setting Up Linux for Firewalling Testing a Firewall Configuration; A Sample Firewall Configuration: IP Accounting, Configuring the Kernel for IP Accounting, Configuring IP Accounting, Using IP Accounting Results

**IP Masquerade and Network Address Translation :** Side Effects and Fringe Benefits, Configuring the Kernel for IP Masquerade, Configuring IP Masquerade.

## **Unit-V**

**The Network Information System :** Getting Acquainted with NIS, NIS Versus NIS+ , The Client Side of NIS, Running an NIS Server, NIS Server Security.

**Network file system:** Preparing NFS, Mounting an NFS Volume, The NFS Daemons, The exports File.

**System Backup & Recovery:** Log files for system and applications; Backup schedules and methods (manual and automated).

## **Text Books:**

1. L.L. Beck – “System Software “ (3rd Ed.)- Pearson Education
2. Michel Ticher – “PC System Programming” , Abacus.
3. Kirch – “ Linux network Administrator’s guide (2nd Ed.)” – O’Rielly
4. Maxwell – “Unix system administration” - TMH

5. Limoncelli –“The Practice of System & Network Administration”-Pearson

6. Wells, LINUX Installation & Administration, Vikas

**Reference Books:**

1. W. R. Stevens – “Unix network programming, vol. 1(2nd Ed.)” – Pearson Education/PHI

2. W. R. Stevens – “TCP/IP illustrated, vol. 1” – PHI/Pearson Education

3. Comer – “Internetworking with TCP/IP, vol. 1(4th Ed.)” – Pearson Education/PHI

4. E. Nemeth, G. Snyder, S. Seebass, T. R. Hein – “ Unix system administration handbook” – Pearson Education

## **(CS024) Soft Computing**

### **Unit –I**

Introduction to soft computing. Applications of Artificial Neural Networks, fuzzy logic, genetic algorithms and other soft-computing techniques. Their strengths and weaknesses. Synergy of soft computing techniques.

Artificial neural networks : over view of history, Mathematical Models of Neurons, ANN architecture.

### **Unit-II**

Introduction to artificial neural network

Neural Networks: Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Competitive learning networks, Kohonen self organizing networks, Hebbian learning; Hopfield Networks,

### **Unit-III**

Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation.

Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations.

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

### **Unit - IV**

Genetic algorithms(Gas),Evolution strategies(Ess),Evolutionary programming(EP),Genetic Programming(GP),Selecting, crossover, mutation, schema analysis, analysis of selection algorithms; convergence; Markov & other stochastic models.

### **Unit - V**

Other Soft computing approaches Simulated Annealing, Tabu Search, Ant colony based optimisation, etc.

**Text:**

1. "Neuro-Fuzzy and Soft computing", Jang, Sun, Mizutani, Pearson
2. "Neural networks: a comprehensive foundation", Haykin, Pearson
3. "Genetic Algorithms", Goldberg, Pearson
4. "Fuzzy Sets & Fuzzy Logic", G.J. Klir & B. Yuan, PHI.

**Reference:**

1. "An Introduction to Neural Networks", Anderson J.A., PHI, 1999.
2. "Introduction to the Theory of Neural Computation", Hertz J. Krogh, R.G. Palmer, Addison- Wesley, California, 1991.
3. "An Introduction to Genetic Algorithm", Melanie Mitchell, PHI, 1998.
4. "Neural Networks-A Comprehensive Foundations", Prentice-Hall International, New Jersey, 1999.
5. "Neural Networks: Algorithms, Applications and Programming Techniques", Freeman J.A. & D.M. Skapura, Addison Wesley, Reading, Mass, (1992).

## (TCS-801) DISTRIBUTED SYSTEMS

### Unit-I

**Characterization of Distributed Systems:** Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges.

**System Models:** Architectural models, Fundamental Models

**Theoretical Foundation for Distributed System:** Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks, Causal ordering of messages, global state, termination detection.

**Distributed Mutual Exclusion:** Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non token based algorithms, performance metric for distributed mutual exclusion algorithms.

### Unit-II

**Distributed Deadlock Detection:** system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.

**Agreement Protocols:** Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system.

### Unit-III

**Distributed Objects and Remote Invocation:** Communication between distributed objects, Remote procedure call, Events and notifications, Java RMI case study.

**Security:** Overview of security techniques, Cryptographic algorithms, Digital signatures Cryptography pragmatics, Case studies: Needham Schroeder, Kerberos, SSL & Millicent.

**Distributed File Systems:** File service architecture, Sun Network File System, The Andrew File System, Recent advances.

### Unit-IV

**Transactions and Concurrency Control:** Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control.

**Distributed Transactions:** Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.



### **Unit –V**

**Distributed Algorithms:** Introduction to communication protocols, Balanced sliding window protocol, Routing algorithms, Destination based routing, APP problem, Deadlock free Packet switching, Introduction to Wave & traversal algorithms, Election algorithm.

**CORBA Case Study:** CORBA RMI, CORBA services.

### **Books:**

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Ed.
3. Gerald Tel, "Distributed Algorithms", Cambridge University Press

## **(TCS-802) MOBILE COMPUTING**

### **Unit – I**

Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

### **Unit - II**

Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

### **Unit – III**

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations.

### **Unit - IV**

Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

### **Unit – V**

Ad Hoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

### **Books:**

1. J. Schiller, Mobile Communications, Addison Wesley.
2. A. Mehrotra , GSM System Engineering.
3. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.
4. Charles Perkins, Mobile IP, Addison Wesley.
5. Charles Perkins, Ad hoc Networks, Addison Wesley.

## **(CS – 031) EMBEDDED SYSTEMS**

### **Unit-I**

Introduction to embedded systems: Classification, Characteristics and requirements

### **Unit-II**

Timing and clocks in Embedded systems, Task Modeling and management, Real time operating system issues.

### **Unit-III**

Signals, frequency spectrum and sampling, digitization (ADC, DAC), Signal Conditioning and Processing. Modeling and Characterization of Embedded Computation System.

### **Unit-IV**

Embedded Control and Control Hierarchy, Communication strategies for embedded systems: Encoding and Flow control.

### **Unit-V**

Fault-Tolerance

Formal Verification.

### **Books:**

1. H.Kopetz, "Real-Time Systems", Kluwer, 1997.
2. R.Gupta, "Co-synthesis of Hardware and Software for Embedded Systems", Kluwer 1995.
3. Rajkamal, "Embedded Systems", TMH, 2008

## **(CS - 032) PARALLEL COMPUTING**

### **UNIT-1**

Introduction: What is parallel and distributed computing, Scope of parallel and distributed computing, Scope of parallel computing. Parallel Programming Platforms: implicit parallelism, Dichotomy of parallel computing platforms, Physical organization for parallel platforms, communication cost in parallel machines, routing mechanism for interconnection networks.

### **UNIT-2**

Basic Communication Operation: One-to-all broadcast; All-to-all broadcast; Reduction and prefix sums; One-to-all personalized communication; All-to-all personalized communication;

### **UNIT-3**

Performance and Scalability of Parallel Systems: Performance matrices for Parallel systems ? Run time, Speed up, Efficiency and Cost; The effect of granularity on performance

#### **UNIT-4**

Sorting: Sorting networks; Bubble sort and its variants; Quick sort and other sorting algorithms

#### **UNIT-5**

Dynamic Programming: Overview of dynamic programming, Serial monadic DP Formulations: The shortest path Problem, the 0/1 Knapsack Problem, Serial Polyadic DP Formulation : all pair shortest paths algorithms.

#### **References:**

1. Vipin Kumar, Ananth Grama, Anshul Gupta and George Karypis; Introduction to Parallel Computing, The Benjamin/Cumming Publishing Company, Inc., Massachusetts
2. George Coulouris, Jean Dollimore and Tim Kindberg; Distributed Systems Concepts and Design, Addison-Wesley, Massachusetts
3. S G Akl; The Decision and analysis of parallel algorithms, PH Englewood Cliffs, New Jersey.
4. Advanced Computer Architecture: Parallelism, Scalability, Programmability, TMH.
5. J Jaja; An Introduction to Parallel Algorithms, Addison Wesley, Massachusetts.
6. T G Lewis and H El ?Rewini; Introduction to Parallel Computing, Prentice-Hall, Englewood Cliffs, New Jersey.
7. M J Quinn; Parallel Computing: Theory and Practice, McGraw-Hill, New York.

### **(CS – 033) MULTIMEDIA COMMUNICATION & SYSTEM DESIGN**

#### **Unit-I: Introduction**

Introduction to Multimedia, Multimedia Information, Multimedia Objects, Multimedia in business and work. Convergence of Computer, Communication and Entertainment products

#### **Stages of Multimedia Projects**

Multimedia hardware, Memory & storage devices, Communication devices, Multimedia software's, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools.

#### **Unit-II: Multimedia Building Blocks**

Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture.

### **Unit-III: Data Compression**

Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding, Arithmetic Coding Higher Order Modelling. Finite Context Modelling, Dictionary based Compression, Sliding Window Compression, LZ77, LZW compression, Compression, Compression ratio loss less & lossy compression.

### **Unit-IV: Speech Compression & Synthesis**

Digital Audio concepts, Sampling Variables, Loss less compression of sound, loss compression & silence compression.

### **Unit-V: Images**

Multiple monitors, bitmaps, Vector drawing, lossy graphic compression, image file format animations Images standards, JPEG Compression, Zig Zag Coding, Multimedia Database. Content based retrieval for text and images, **Video:** Video representation, Colors, Video Compression, MPEG standards, MHEG Standard Video Streaming on net, Video Conferencing, Multimedia Broadcast Services, Indexing and retrieval of Video Database, recent development in Multimedia.

### **Books:**

1. Tay Vaughan "Multimedia, Making IT Work" Osborne McGraw Hill.
2. Buford "Multimedia Systems" Addison Wesley.
3. Agrawal & Tiwari "Multimedia Systems" Excel.
4. Mark Nelson "Data Compression Book" BPB.
5. David Hillman "Multimedia technology and Applications" Galgotia Publications.
6. Rosch "Multimedia Bible" Sams Publishing.
7. Sleinreitz "Multimedia System" Addison Wesley.
8. James E Skuman "Multimedia in Action" Vikas.

## **(CS – 034) PATTERN RECOGNITION**

### **Unit – 1 Introduction**

Pattern recognition, classification and description, patterns and features extraction, training and learning in PR systems, pattern recognition approaches

### **Unit – 2**

#### **Pattern Discrimination**

Decision regions and functions, feature Space Metrics, The Covariance Matrix, Principal components, feature assessment, dimensionality ratio problem

#### **Data Clustering**

Unsupervised classification, Standardization issues, tree clustering, dimensional reduction, K-means clustering, cluster validation

### **Unit – 3      Statistical Classifications**

Linear Discriminants, Bayesian classification, Model free techniques, feature selection, classifier evaluation, tree classifier

### **Unit – 4      Syntactic pattern recognition**

Introduction, quantifying structure in pattern description, grammar based approach and applications, elements of formal grammars, recognition of syntactic descriptions, parsing, CYK parsing algorithm

### **Unit – 5      Structural pattern recognition**

Primitives, structural representations, syntactic analysis, structural matching

#### **Text Books:**

1. Pattern Recognition: Statistical, structural and neural approaches, Robert J. Schalkoff, WILEY 1992
2. Pattern Recognition: Concepts, Methods and applications, J.P. Marques, Springer 2008
3. Pattern Recognition: Techniques and applications, rajjan Shinghal, Oxford University Press, 2006

## **(CS-035) NATURAL LANGUAGE PROCESSING**

### **Unit-I**

Introduction to Natural Language Understanding: The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

### **Unit-II**

Introduction to semantics and knowledge representation, Some applications like machine translation, database interface.

### **Unit-III**

Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

#### **Unit-IV**

Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

#### **Unit-V**

Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

#### **Books:**

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, *NLP: A Paninian Perspective*, Prentice Hall, New Delhi
2. James Allen, *Natural Language Understanding*, 2/e, Pearson Education, 2003
3. D. Jurafsky, J. H. Martin, *Speech and Language Processing*, Pearson Education, 2002
4. L.M. Ivasca, S. C. Shapiro, *Natural Language Processing and Language Representation*
5. T. Winograd, *Language as a Cognitive Process*, Addison-Wesley

### **(CS – 041) ADVANCED DATABASE SYSTEMS**

#### **UNIT-1**

Distributed DBMS Concepts and design: Introduction, functions and architecture of a DDBMS, distributed relational database design, Transparencies in a DDBMS, Twelve rules for a DDBMS. Advanced concepts: Distributed transaction management, distributed concurrency control, distributed deadlock management, distributed database recovery, X/open distributed Transaction processing model, Replication servers, Distributed query optimization, Mobile databases.

#### **UNIT-2**

Object-Oriented DBMS Introduction, advanced database applications, weakness of RDBMS, storing objects in a relational database, next-generation database systems. Concepts and design: OODBMS perspectives, persistence, issues in OODBMS, advantages and disadvantages of OODBMS, Object-oriented database design.

#### **UNIT-3**

Standards and systems: object management group, object database standard ODMG 3.0 1999, Object store. Object relational DBMS: Introduction, third generation database manifestos, SQL8, Object oriented extensions in Oracle, Comparison of ORDBMS and OODBMS.

#### **UNIT-4**

Web technology and DBMS Web as a database Application Platform: Requirements for web-DBMS integration, web-DBMS architecture, advantages and disadvantages of web-DBMS approach, approaches to integrating the web and DBMS, Oracle Internet Application Server (IAS).

## **UNIT-5**

Data Warehousing Concepts, OLAP and Data mining Evolution of data warehousing, data warehousing concepts, benefits and problems of data warehousing, comparison of OLTP systems and data warehousing, On-Line Processing, Introduction to data mining.

### **Books:**

1. Adam, Nabil R., Bhargava, Bharat K., “Advanced Database Systems”, Springer.
2. Carlo Zaniolo, Stefano Ceri, “Advanced Database Systems”, Morgan Kaufmann, 1997

## **(CS – 042) DATA MINING AND WAREHOUSING**

### **Unit-I**

Overview, Motivation(for Data Mining),Data Mining-Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Computer and Human inspection),Inconsistent Data, Data Integration and Transformation. **Data Reduction**:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

### **Unit-II**

**Concept Description**:- Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical class Description, Mining Association Rules in Large Databases, Association rule mining, mining Single-Dimensional Boolean Association rules from Transactional Databases– Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases and Mining Multi-Dimensional Association rules from Relational Databases.

### **Unit-III**

#### **Classification and Predictions:**

What is Classification & Prediction, Issues regarding Classification and prediction, Decision tree, Bayesian Classification, Classification by Back propagation, Multilayer feed-forward Neural Network, Back propagation Algorithm, Classification methods Knearest neighbor classifiers, Genetic Algorithm.

#### **Cluster Analysis:**

Data types in cluster analysis, Categories of clustering methods, Partitioning methods. Hierarchical Clustering- CURE and Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based Methods- STING, CLIQUE, Model Based Method –Statistical Approach, Neural Network approach, Outlier Analysis

#### **Unit-IV**

**Data Warehousing:** Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.

#### **Unit-V**

Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse.

#### **Books:**

1. M.H.Dunham,"Data Mining:Introductory and Advanced Topics" Pearson Education
2. Jiawei Han, Micheline Kamber, "Data Mining Concepts & Techniques" Elsevier
3. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems, 1/e " Pearson Education
4. Mallach,"Data Warehousing System",McGraw –Hill

### **(CS – 043) COMPUTATIONAL GEOMETRY**

#### **UNIT-I**

Convex hulls: construction in 2d and 3d, lower bounds; Triangulations: polygon triangulations, representations, point-set triangulations, planar graphs;

#### **UNIT-II**

Voronoi diagrams: construction and applications, variants; Delaunay triangulations: divide-and-conquer, flip and incremental algorithms, duality of Voronoi diagrams, minmax angle properties;

#### **UNIT-III**

Geometric searching: point-location, fractional cascading, linear programming with prune and search, finger trees, concatenable queues, segment trees, interval trees; Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems;

#### **UNIT-IV**

Arrangements of lines: arrangements of hyper planes, zone theorems, many-faces complexity and algorithms; Combinatorial geometry: Ham-sandwich cuts.

#### **UNIT-V**

Sweep techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements; Randomization in computational geometry: algorithms, techniques for counting; Robust geometric computing; Applications of computational geometry;



**Books:**

1. *Computational Geometry: An Introduction* by Franco P. Preparata and Michael Ian Shamos; SpringerVerlag, 1985.
2. *Computational Geometry, Algorithms and Applications* by Mark de Berg, Marc van Kreveld, Mark Overmars, and Otfried Schwarzkopf; Springer-Verlag, 1997. from Springer.
3. *Algorithmische Geometrie* (auf deutsch) by Rolf Klein Addison-Wesley, 1996
4. *Computational Geometry and Computer Graphics in C++* by Michael J. Laszlo (Nova Southeastern University) Prentice-Hall, 1996.
5. *Computational Geometry: An Introduction Through Randomized Algorithms* by Ketan Mulmuley Prentice-Hall, 1994
6. *Computational Geometry in C* by Joseph O'Rourke Cambridge University Press, second edition, 1998.

**(CS – 044) GRANULAR COMPUTING****Unit – 1 Methodology and mathematical framework**

Information Granules, Formal models of information granules, conceptual aspects, granular world, granular computing: pyramid, communication between granular works.

**Unit – 2 Sets and Intervals**

Formalism of sets, set enclosure, Interval analysis, Interval Vectors, Interval Matrices, enclosure of functions.

**Fuzzy Sets**

Concept and formalism, geometry of fuzzy sets, main classes, operations on fuzzy sets, relationships, transformation, fuzzy arithmetic

**Rough sets**

Concept, set approximation, characterization, rough functions.

**Unit – 3****Algorithm of Information Granulation**

Principle of granular clustering, computational aspects of granular computing, granular analysis

**Recursive information granulation**

Introduction, design and characterization of information granules, assessment and Interpretation, Granular time series.

#### **Unit – 4 Granular Systems Application**

Temporal granulation and signal analysis, Granulation of signals in spatial domain, Granular models of signals, rough sets in signal granulation.

#### **Unit – 5 Granular Data Compression**

Fuzzy relational equations, relational calculus in image compression, experiments.

#### **Text Books:**

1. Granular computing: An introduction Andrez bargiela, Witold Pedrycz, Kluwer Academic Publisher, 2003
2. Handbook Of Granular Computing, Witold Pedrycz, Andrzej Skowron, Vladik Kreinovich, by Wiley.
3. Rough Sets, Fuzzy Sets, Data Mining, and Granular Computing, Slezak, Wang, Szczuka, Springer, 2005.

### **(CS-045) STORAGE NETWORKS**

#### **Unit – 1 Introduction to Storage Technology**

Introduction to storage network, Five pillars of IT, parameters related with storage, data proliferation, problem caused by data proliferation, Hierarchical storage management, Information life cycle management (ILM), Role of ILM, Information value vs. time mapping, Evolution of storage, Storage infrastructure component, basic storage management skills and activities, Introduction to Datacenters, Technical & Physical components for building datacenters

#### **Unit – 2 Technologies for Storage network**

Server centric IT architecture & its limitations, Storage centric IT architecture & advantages, replacing a server with storage networks, Disk subsystems, Architecture of disk subsystem, Hard disks and Internal I/O channel, JBOD, RAID& RAID levels, RAID parity, comparison of RAID levels, Hot sparing, Hot swapping, Caching : acceleration of hard disk access, Intelligent Disk subsystem architecture,

#### **Tape drives**

Introduction to tape drives, Tape media, caring for Tape& Tape heads, Tape drive performance, Linear tape technology, Helical scan tape technology

### **Unit- 3 I/O techniques**

I/O path from CPU to storage systems, SCSI technology – basics & protocol, SCSI and storage networks, Limitations of SCSI,

#### **Fibre channel**

Fibre channel, characteristic of fibre channel, serial data transfer vs. parallel data transfer, Fibre channel protocol stack, Links, ports & topologies, Data transport in fibre channel, Addressing in fibre channel, Designing of FC-SAN, components, Interoperability of FC-SAN, FC products,

#### **IP Storage**

IP storage standards (iSCSI, iFCP, FCIP, iSNS), IPSAN products, Security in IP SAN, introduction to infiniband, Architecture of Infiniband

NAS – Evolution, elements & connectivity, NAS architecture,

### **Unit – 4 Storage Virtualization**

Introduction to storage virtualization, products, definition, core concepts, virtualization on various levels of storage network, advantages and disadvantages, Symmetric and asymmetric virtualization, performance of San virtualization, Scaling storage with virtualization

### **Unit – 5 Management of storage Networks**

Management of storage network, SNMP protocol, requirements of management systems, Management interfaces, Standardized and proprietary mechanism, In-band& Out-band management,

#### **Text Book:**

1. "Storage Networks: The Complete Reference", R. Spalding, McGraw-Hill
2. "Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems", Marc Farley, Cisco Press.
3. "Designing Storage Area Networks: A Practical Reference for Implementing Fibre Channel and IP SANs, Second Edition", Tom Clark Addison Wesley