ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.Tech.
Parallel Computing

(Effective for the students admitted from the Academic Year 2007-08)

Jawaharlal Nehru Technological University
Hyderabad – 500 085

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

M.Tech. (Parallel Computing) **w.e.f.(2007-2008)**

COURSE STRUCTURE

I-Semester

Code	Subject	L	P
MTPC 1.1	Parallel Algorithms	4	-
MTPC 1.2	Parallel Computer Architecture	4	-
MTPC 1.3	Distributed Operating Systems	4	-
MTPC 1.4	Adhoc and Sensor Networks	4	-
MTPC 1.5	Elective - I	4	-
MTPC 1.6	Elective - II	4	-
Practical MTPC 1.7	Parallel Programming Lab	-	3

II-Semester

Code	Title	L	P
MTPC 2.1	Distributed Databases	4	-
MTPC 2.2	Cluster & Grid Computing	4	-
MTPC 2.3	Information Retrieval Systems	4	-
MTPC 2.4	Information Security	4	-
MTPC 2.5	Elective -III	4	-
MTPC 2.6	Elective - IV	-	-
Practical MTPC 2.7	Parallel and Grid Computing Lab	-	4

III-Semester

Project Seminar Satisfactory/Not-Satisfactory

IV-Semester

Project Seminar
Dissertation/Thesis Excellent/good/Satisfactory/Not-Satisfactory

Note: *Eligibility for admission to this course is B.E./B.Tech. in Computer Science and Engineering, Information Technology.*

ELECTIVES

Elective I
MTPC 1.5.1 Web Technologies
MTPC 1.5.2 Software System Design

Elective II
MTPC 1.6.1 Image Processing and Machine Vision
MTPC 1.6.2 Embedded Systems

Elective III
MTPC 2.5.1 Neural Networks
MTPC 2.5.2 Pattern Recognization

Elective IV
MTPC 2.6.1 Storage Area Networks
MTPC 2.6.2 High Performance Networking

First Semester

PARALLEL ALGORITHMS

Unit – I

Parallel Computers and Computation: Parallelism and Computing, Trends in Applications, Trends in Computer Design, Trends in Networking, Parallel Machine Model, The Multi-computer, Other Machine Models, A Parallel Programming Model, Tasks and Channels, Other Programming Models.

Unit – II

Parallel Algorithm Examples, Finite Differences, Pair-wise Interactions, Search, Parameter Study.

Unit – III

Designing Parallel Algorithms, Methodical Design, Partitioning, Domain Decomposition, Functional Decomposition, Partitioning Design Checklist, Communication, Local Communication, Global Communication, Distributing Communication and Computation. Uncovering Concurrency: Divide and Conquer, Unstructured and Dynamic Communication, Asynchronous Communication.

Unit – IV

Agglomeration: Increasing Granularity, Surface-to-Volume Effects, Replicating Computation, Avoiding Communication, Preserving Flexibility, Reducing Software, Engineering Costs, Mapping, Load-Balancing Algorithms, Recursive Bisection, Local Algorithms, Probabilistic Methods, Cyclic Mappings, Task-Scheduling Algorithms, Manager/Worker, Hierarchical Manager/Worker, Decentralized Schemes, Termination Detection.

Unit – V

Case Studies: Atmosphere Model, Floorplan Optimization, Computational Chemistry.

Unit – VI

A Quantitative Basis for Design, Defining Performance, Approaches to Performance Modeling, Amdahl's Law, Extrapolation from Observations, Asymptotic Analysis, Developing Models, Execution Time, Computation Time, Communication Time, Idle Time, Efficiency and Speedup, Scalability Analysis, Scalability with Fixed Problem Size, Scalability with Scaled Problem Size, Experimental Studies, Experimental Design, Obtaining and Validating Experimental Data, Fitting Data to Models.

Unit – VII

Interconnection Networks, Crossbar Switching Network, Bus-based Networks, Ethernet, Mesh Networks, Hypercube Network, Multistage Interconnection Networks, Input/Output, Case Study: Shortest-Path Algorithms, Floyd's Algorithm, Parallel Floyd 1, Parallel Floyd 2, Dijkstra's Algorithm, Parallel Dijkstra 1, Parallel Dijkstra 2, Shortest-Path Algorithms Summary.

Unit – VIII

Modular Design Review, Provide simple interfaces, Ensure that modules hide information, Use appropriate tools, Modularity and Parallel Computing, Data Distribution, Sequential Composition, Parallel Composition, Concurrent Composition,

Design Rules, Performance Analysis, Case Study: Matrix Multiplication, Parallel Matrix-Matrix Multiplication, Redistribution Costs, A Systolic Algorithm.

Text Book:

1. Ian Foster, *Designing and Building Parallel Programs*, Adison Wisley, 1995.

First Semester

PARALLEL COMPUTER ARCHITECTURE

UNIT, I

Parallel Computer Architecture: Trends, Convergence of Parallel Architecture, Fundamental Design Issues.

UNIT, II

Programming for Performance: Partitioning, Data Access and Communication in a Multi memory Systems, Implications for Programming Models.

UNIT, III

Shared Memory Multiprocessors: Cache Coherence, Memory Consistency, Design Space for Snooping Protocols, Assessing Protocol Design Trade-Offs, Synchronization, Implications for Software.

UNIT, IV

Snoop-Based Multiprocessor Design: Correctness requirements, Multilevel cache Hierarchies, Split Transaction Bus, Case Studies: SGI challenge and Sun Enterprise 6000, Extending Cache Coherence.

UNIT, V

Directory-Based Cache Coherence: Scalable Cache Coherence, Overview of Directory Based Approaches, Assessing Directory Protocols and Trade-Offs, Design Challenges for Directory Protocols, Memory based Directory Protocols, The SGI Origin Systems.

Cache based Directory Protocols: The sequent NUMA-Q, Performance Parameters and Protocol Performance, Synchronization, Implication for Parallel Software, Advanced Topics.

UNIT, VI

Hardware / Software Trade-Offs: Relaxed Memory Consistency Models, Overcoming Capacity Limitations, Reducing Hardware Cost.

Putting it all together: A taxonomy and simple COMA, Implications for Parallel Software, Advanced Topics.

UNIT, VII

Interconnection Network Design: Basic Definitions, Basic Communication Performance, Organizational Structure, Interconnection Topologies, Evaluating Design Trade-Offs in Network Topology, Routing, Switch Design, Flow control, Case studies.

UNIT, VIII

Latency Tolerance: Overview of latency tolerance, Latency tolerance in Explicit Message Parsing, Latency Tolerance in a Shared Address Space, Block data Transfer in a Shared Address Space, Proceeding Past Long-Latency Events, Precommunication in a Shared Address Space, Multithreading in a Shared Address Space, Lockup-Free Cache Design.

Future Directions: Technology and Archetecture, Applications and System Software.

Text Book:

1. Id E Culler, Jaswinder Pal Singh and Anoop Gupta, *Parallel Computer Archetecture*, Mogan Kaufman, Elsevier Science, India, 2002.

Reference Books:

1 Kai Hwang, *Advanced Computer Architecture*, Mc Graw Hill, 1999.
2 John L Hennessy, David A Patterson, *Computer Archetecture A Quantitative Approach*, Morgan Kaufmann Publishers Inc, 1996.

First Semester

DISTRIBUTED OPERATING SYSTEMS

UNIT - I

Characterization of Distributed Systems, Design issues, User requirement, Network Technologies and Protocols, IPC, Client - Server communication, Group communication, IPC in UNIX.

UNIT - II

Remote Procedure Calling, Design issues, Implementation, Asynchronous RPC. Distributed OS, its Kernel, Processes and Threads, Naming and Protection, Communication and Invocation, Virtual memory, File service components, Design issues, interfaces, Implementaion techniques, SUN Network File System.

UNIT - III

SNS - a name service model, its design issues, Synchronizing physical clocks, Logical time and logical clocks, Distributed coordination. Replication and its architectural model, Consistency and request ordering, Conversation between aclient and a server, Transactions, Nested Transactions.

Concurrency control, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control.

UNIT - IV

Distributed Transactions and Nested Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed Deadlocks, Transactions with replicated data, Transaction recovery, Fault tolerance, Hierarchical and group masking of faults.

UNIT -V

Cryptography, Authentication and key disribution, Logics of Authentication, Digital signatures.

Distributed shared memory, Design and Implementation issues, Sequential consistency and Ivy, Release consistency and Munin, Overview of Distributed Operating systems Mach, Chorus.

TEXT BOOKS

T1. G. Coulouris, J. Dollimore, *Distributed Systems Concepts and Design* - Addison Wesley.
T2. Andrew. S. Tanenbaum, *Distributed Operating Systems*, Pearson Education, Asia 2000.
T3. Andrew S. Tanenbaum, *Modern operating systems* PHI.

REFERENCE BOOKS

R1. Advance concepts in O/S, M. Singhal, N.G. Shivarathri, TMH.
R2. Distributed Systems, J. Bacon, Pearson Education.
R3. Distributed Database systems, D Bell and J. Graimson, Pearson Education.

First Semester

ADHOC AND SENSOR NETWORKS

UNIT I

Introduction to Ad Hoc Networks: Characteristics of MANETs, applications of MANETs, and challenges of MANETs.

UNIT II

Routing in MANETs: Criteria for classification, Taxonomy of MANET routing algorithms, Topology based routing algorithms, Position based routing algorithms, Other routing algorithms

UNIT III

Data Transmission: Broadcast storm problem, Broadcasting, Multicasting and Geocasting

UNIT IV

TCP over Ad Hoc: TCP protocol overview, TCP and MANETs, and Solutions for TCP over Ad hoc

UNIT V

Basics of Wireless Sensors and Applications: Applications, Classification of sensor networks, Architecture of sensor networks, Physical layer, MAC layer, Link layer,

UNIT VI

Data Retrieval in Sensor Networks: Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs, and Sensor Networks and mobile robots.

UNIT VII

Security: Security in ad hoc networks, Key management, Secure routing, Cooperation in MANETs, and Intrusion detection systems.

UNIT VIII

Sensor Network Platforms and Tools: Sensor Network Hardware, Berkeley motes, Sensor Network Programming Challenges, Node-Level Software Platforms, *Operating system:* TinyOS, *Imperative language*: nesC, Dataflow style language: TinyGALS, Node-Level Simulators, ns-2 and its sensor network extensions, TOSSIM.

Textbook:

1. *Ad hoc and Sensor Networks* - Theory and Applications, by Carlos Cordeiro and Dharma P. Agrawal, World Scientific Publications, March 2006, ISBN 981-256-681-3.
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science ISBN: 978-1-55860-914-3, (Morgan Kauffman)

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First Semester

WEB TECHNOLOGIES
(ELECTIVE, I)

UNIT- I

HTML Common tags, List, Tables, images, forms, Frames; Cascading Style sheets;

UNIT II

Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script

UNIT III

XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX

UNIT IV

Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizes, Java Beans API, Introduction to EJB's

UNIT V

Web Servers: Introduction to Servelets: Lifecycle of a Serverlet, JSDK, The Servelet API, The javax.servelet Package, Reading Servelet parameters, Reading Initialization parameters. The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues,

UNIT VI

Introduction to JSP: The Problem with Servelet. The Anatomy of a JSP Page, JSP Processing. JSP Application Design with MVC Setting Up and JSP Environment: Installing the Java Software Development Kit, Tomcat Server & Testing Tomcat

UNIT VII

JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing, Displaying Values Using an Expression to Set an Attribute, Declaring Variables and Methods Error Handling and Debugging Sharing Data Between JSP pages, Requests, and Users Passing Control and Date between Pages, Sharing Session and Application Data, Memory Usage Considerations

UNIT VIII

Database Access: Database Programming using JDBC, Studying Javax.sql.* package,Accessing a Database from a JSP Page, Application, Specific Database Actions,Deploying JAVA Beans in a JSP Page, Introduction to struts framework..

SUGGESTED READINGS:

1. Chris Bates, *Web Programming, building internet applications,* 2nd edition, WILEY Dreamtech (UNIT s 1,2 ,3)
2. Patrick Naughton, Herbert Schildt, *The complete Reference Java 2 Fifth Edition* TMH (Chapters: 19, 20, 21, 22, 25, 27) (UNIT 4)
3. Hans Bergsten, *Java Server Pages,* SPD O'Reilly (UNITs 5,6,7,8)

TEXT BOOKS:

1. Internet and World Wide Web, How to program by Dietel and Nieto PHI/Pearson Education Asia.
2. Jakarta Struts Cookbook , Bill Siggelkow, S P D O'Reilly for chap 8.

Reference Books:

3. Murach's beginning JAVA JDK 5, Murach, SPD
4. An Introduction to web Design and Programming –Wang-Thomson
5. Web Applications Technologies Concepts-Knuckles,John Wiley
6. Programming world wide web-Sebesta,Pearson
7. Building Web Applications-NIIT,PHI
8. Web Warrior Guide to Web Programmming-Bai/Ekedaw-Thomas
9. Beginning Web Programming-Jon Duckett WROX.
10. Java Server Pages, Pekowsky, Pearson.

First Semester

SOFTWARE SYSTEM DESIGN
(ELECTIVE, I)

UNITII :

Process models : The waterfall model, Incremental process models, Evolutionary process models, The Unified process.

Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document.

UNIT III :

Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

System models : Context Models, Behavioural models, Data models, Object models, structured methods.

UNIT IV :

Design Engineering : Design process and Design quality, Design concepts, the design model.

Creating an architectural design : Software architecture, Data design, Architectural styles and patterns, Architectural Design.

UNIT V :

Object-Oriented Design : Objects and object classes, An Object-Oriented design process, Design evolution.

Performing User interface design : Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation.

UNIT VI :

Testing Strategies : A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging.

Product metrics : Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.

UNIT VII :

Metrics for Process and Products : Software Measurement, Metrics for software quality.

Risk management : Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.

UNIT VIII :

Quality Management : Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

TEXT BOOKS :

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition.McGrawHill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson education.

REFERENCES :

1. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers
2. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiely.
3. Systems Analysis and Design- Shely Cashman Rosenblatt,Thomson Publications.
4. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.

First Semester

IMAGE PROCESSING AND MACHINE VISION
(ELECTIVE II)

Unit – I Digital Image Processing Introduction, The digital image and its properties, Basic concepts, Image functions, The Dirac distribution and convolution, The Fourier transform, Image as stochastic process, Images as linear systems, Image digitization, sampling, quantization, color image, Digital image properties, metric and topological properties of digital images, histograms, visual perception, image quality, noise.

Unit – II Image pre-processing, Pixel brightness transformations, position dependent brightness correction, grey scale transformation, Geometric transformations, pixel co-ordinate transformations, brightness interpolation, image smoothing, edge detectors, zero-crossings of the second derivative, scale in image processing, Canny edge detection, parametric edge models, edge in multi-spectral images, other local pre-processing operators, adaptive neighborhood pre-processing.

Unit – III Segmentation, Thresholding, threshold detection methods, optimal thresholding, multi-spectral thresholding, thresholding hierarchical data structures, Edge-based segmentation, edge image thresholding, edge relaxation, border tracing, border detection as graph searching, border detection as dynamic programming, Hough transforms, border detection using border location information, Region-based segmentation, region merging, region splitting, splitting and merging, region growing post-processing, Matching criteria, Control strategies of matching.

Unit – IV Shape representation and description, Region identification, Contour-based representation and description, chain codes, simple geometric border representation, Fourier transforms of boundaries, boundary description using segment sequences, B-spline representation, other contour-based shape description approaches, Region-based shape representation and discreption, simple scalar region descriptors, moments, convex hull.

Unit – V Mathematical morphology, Basic concepts, morphological principles, binary dilation and erosion, grey scale dilation and erosion, ske;tons and object marking, granulometry.

Unit – VI Object recognition, Knowledge representation, Statistical pattern recognition, classification principles, classifier setting, classifier learning, cluster analysis, Neural nets, feed-forward networks, unsupervised learning, Hopfield nueral nets, Syntactic pattern recognition, grammars and languages, syntactic analysis, syntactic classifier, syntactic classifier learning, grammar inference, recognition as graph matching, isomorphism of graphs and sub-graphs, similarity of graphs, optimization techniques in recognition.

Unit – VII Image understanding, Image understanding control strategies, parallel and serial processing control, hierarchical control, bottom-up control strategies, model-based control strategies, combined control strategies, non-hierarchical models, point distribution models, pattern recognition methods in image recognition, contextual image classification, scene labeling and constraint propagation, semantic image segmentation and understanding, hidden Markov models.

Unit – VIII 3D vision tasks, Marr's theory, other vision paradigms, Geometry for 3D vision, basics of projective geometry, the single perspective camera, single camera calibration, calibration of one camera from known scene, two cameras, stereopsis, geometry of two cameras, fundamental matrix, relative motion of cameras, the essential matrix, applications of epipolar geometry in vision, three and more cameras, stereo correspondence algorithms, active acquisition of range images, Radiometry and 3D vision.

TEXT BOOK: Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis, and Machine Vision*, Thompson Publishing Company, 1999.

REFERENCE BOOKS:

1. Rafel C, Gonzalez Richard E. Woods, *Digital Image Processing*, PHI/Pearson Edition, second Edition.
2. Julus T. Tou and Rafel C. Gonzalez, *Pattern Recognition Principles*, Addision Wesley Publication Company.
3. Earl Gose, Richard Johnsonbaugh, *Pattern Recognition and Image Analysis*, Printice Hall of India Pvt. Ltd., 1999.

First Semester

EMBEDDED SYSTEM
(ELECTIVE II)

UNIT – 1

Embedded Computing: Introduction, Complex Systems and Microprocessor, The Embedded system Design process, Formalisms for System Design, Design Examples

UNIT – II

The 8051 Architecture: Introduction, 8051 Micro Controller Hardware, Input/Output Ports and Circuits, External Memory, Counter and Timers, Serial Data input/output, interrupts .

UNIT – III

Basic Assembly Language programming Concepts: The assembly language programming Process, programming Tools and Techniques, programming the 8051. Data Transfer and Logical Instructions.

UNIT – IV

Arithmetic Operations, Decimal Arithmetic, Jump and Call Instructions, Further Details on Interrupts, Serial Data Communications.

UNIT – V

Applications: interacting with keyboards, displays, D/A and A/D Conversions, Multiple Interrupts, Serial Data Communication.

UNIT – VI

Introduction to Real - Time Operating systems: Tasks and Task states, Tasks and Data, Semaphores, and shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory management, Interrupt Routines, in an RTOS Environment.

UNIT – VII

Basic Design using a Real Time Operating System: Principles, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory, and Power, An example RTOS like uC-OS (open source); Embedded software Development Tools; Host and Target machines, Linker/Locators for Embedded software, Getting Embedded software into the target system; Debugging Techniques: Testing on Host machine, using laboratory Tools, An Example System.

UNIT – VIII

Introduction to Advanced Architectures: ARM and SHARC, Processor and memory organization and instruction level parallelism; Networked embedded systems; Bus Protocols, I^2C bus and CAN bus; Internet-Enabled Systems, Design Example-Elevator Controller.

TEXT BOOKS:

1. Computers and Components, Wayne Wolf, Elseveir
2. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson,

REFERENCES:

1. Embedded System Building blocks, Labrosse, via CMP publishers.
2. Embedded System, Raj kamal, TMH.
3. Micro Controllers, Ajay V DEshmukhi, TMH
4. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley.
5. Microcontrollers, Rajkamal, Pearson Education.
6. An Embedded Software Primer, David E.Simon, Pearson Education.

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First Semester

PARALELL PROGRAMMING LAB

1. Bridge Construction: Develop a program to create two tasks, `foundry` and `bridge`, and connects them with a channel. The channel should be used to communicate a stream of integer values `1..100` from `foundry` to `bridge`, followed by the value --1 to signal termination.
2. Search (I): Develop a program that uses processor objects and the `par` construct to implement a prototypical tree-structured computation. The program should explore a binary tree recursively creating a task (processor object + thread) for each tree node and returning the total number of leaf nodes that represent solutions. In the program, the tree is not represented by an explicit data structure; instead, a process's position in the tree is represented by an integer.
3. Extend the above program to allow for nonbinary trees: that is, trees with an arbitrary number of subtrees rooted at each node.
4. Design and construct a CC++ implementation of the manager/worker structure used in the parameter study problem.
5. Design and construct a decentralized version of the manager/worker structure developed above. Design and carry out experiments to determine when each version is more efficient.
6. Channel Communication: Global pointers and `sync` variables can be used to implement a variety of communication mechanisms. Use these constructs to implement a simple shared queue class. This class can be used to implement channel communication between two concurrently executing producer and consumer tasks: we simply allocate a queue object and provide both tasks with pointers to this object.
7. Design and implement a program that can be used to quantify CC++ processor object and thread creation costs, both within the same processor and on remote processors. Conduct experiments to measure these costs, and obtain estimates for t_s and t_w.
8. Modify the program developed above to use `spawn` to implement the RPC used for a send operation, and conduct experiments to compare the performance of the two versions.
9. Search (II): Define a global `Mapping` object and initialize at the beginning of `main` to contain the names of the processors on which the program is to execute. These names are read from a file. Provide a constructor for the processor object class `Tree` that copies the `Mapping` object to each new processor object as it is created. One of the processor object allocation should call in the `search` function is augmented with a call to `random_p`, which returns a `proc_t` structure on a randomly selected processor.
10. **Coupled Climate Model**: Implement a coupled climate modeling system comprising an ocean model and an atmosphere model which can be structured as a *parallel composition* of the two component models, in which each model executes on one half of `P` processors as described in the text book.
11. **Finite Difference**: We apply the two approaches to the SPMD finite difference computation used to illustrate sequential composition. This computation may be structured as a sequence of calls to a finite difference routine that performs nearest-

neighbor communication and a reduction routine used to detect termination; the latter routine may perform global communication.

12. Implement and instrument the channel library and use this code to measure CC++ communication costs on various parallel computers.
13. Extend the channel library to allow polling for pending messages.
14. Extend the channel library to provide a merger that allows multiple senders on a channel.
15. Develop a program to provide a 2-D decomposition of principal data structures.
16. Implement a hypercube communication template. Use this template to implement simple reduction, vector reduction, and broadcast algorithms.
17. Construct a CC++ implementation of the tuple space module. Use this module to implement the database search problem described in that section.

Second Semester

DISTRIBUTED DATABASES

UNIT - I

Features of distributed databases versus Centralized databases, Principles of Distributed Databases, levels of Distribution transparency, Reference Architecture for Distributed Databases, types of Data Fragmentation, Integrity constraints in Distributed Databases

UNIT - II

Translation of global queries to fragment queries, Equivalence transformations for queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate function Evaluation, Parametric Queries.

UNIT - III

Optimization of Access Strategies, A Framework for Query Optimization, Join Queries, General Queries.

UNIT - IV

The Management of Distributed Transactions, A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed transactions.

UNIT - V

Concurrency control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic methods for Distributed Concurrency Control.

UNIT - VI

Reliability, Basic concepts, Non blocking Commitment protocols, Reliability and Concurrency Control, Determining a Consistent view of Network, Detection and Resolution of Inconsistencies, check points and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection.

UNIT - VII

Architectural Issues, Alternative Client/Server Architecture, Cache Consistency Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution, Transaction Management, Transaction Management in Object DBMSs, Transaction as Objects.

UNIT - VIII

Database Integration, Scheme Translation, Scheme Integration, Query Processing Layers in Distributed Multi-DBMSs, Query Optimization issues, Transaction Management Transaction and Computation Model Multidatabases Concurrency Control, Multi database Recovery, Object Orientation and Interoperability Object Management Architecture CORBA and Database Interoperability Distributed

Component Model COM/OLE and Database interoperability, PUSH-Based Technologies.

Text Books:

1. Ceri S, Pelagatti G, *Distributed Database systems Principles and Systems*, Mc Graw Hill.
2. Principles of Distributed Database Systems, M.Tamer Qzsu, Patrick Valduriez Pearson Education.

Second Semester

CLUSTER AND GRID COMPUTING

UNIT - I

Introduction to Cluster computing, Eras of Computing, Scalable Parallel Computer Architecture, Towards Low Cost Parallel Computing and Motivations, Windows of Opportunity, A Cluster Computer and its Architecture, Clusters Classification, Commodity Components for Clusters, Network Services / Communications SW, Cluster Middleware and Single System Image (SSI) , Resource Management and Scheduling (RMS), Programming Environments and Tools, Cluster Applications, Representative Cluster System, Cluster of smps (CLUMPS).

UNIT - II

Cluster Setup and Its administration, introduction, Setting up the cluster, Directory Services inside the Cluster, DCE integration, Global Clock synchronization, Heterogeneous Clusters, Security, Security Policies, Finding the Weakest Point in nows and cows, A little Help from a Front-end, Security versus performance Tradeoffs, Clusters of Clusters, System Monitoring, Unsuitability of General Purpose Monitoring Tools, Subjects of Monitoring, Self Diagnosis and Automatic Corrective Procedures, System tuning, Developing Custom Models for Bottleneck Detection, Focusing on Throughput or Focusing on Latency, I/O Implications, Caching Strategies, Fine tuning the OS, Constructing Scalable Services, introduction, Environment, Faults, Delays, and Mobility, Scalability Definition and Measurement, Weak Consistency, Assumptions Summary, Model Definition and Requirements, Resource sharing, introduction, Previous study, Flexible load sharing algorithm, Resource Location study, Algorithm analysis, Resource Sharing Enhanced Locality, State Metric, Basic Algorithm Preserving Mutual Interests, Considering Proximity for Improved Performance, Estimating proximity (latency), Prototype Implementation and Extension, PVM Resource Manager, Resoure manager Extension to further enhance Locality

UNIT - III

Dependable Clustered Computing, introduction, structure, Two Worlds Converge, Dependable Parallel Computing, Mission /Business Critical Computing, Dependability Concepts, Faults, Errors, Failure, Dependability Means, Cluster Architectures, Share –Nothing versus shared-storage, Active / Standby versus active / active, Interconnets, Detecting and Masking Faults, Self Testing, processor, Memory, and Buses, Watch dog Hardware Timers, Loosing the software watchdog, Assertions, consistency checking, and ABFT, Recovering from faults, Check pointing and Rollback, Transactions, failover and Failback, Reconfiguration, The practice of Dependable clustered computing, Microsoft Cluster Server, NCR Life Keeper, Oracle Fail safe and parallel server, Deploying a High Throughput Computing cluster, introduction, Condor overview, software Development, layered software architecture, layered resource management architecture, protocol flexibility, remote file access, Access policies, Reliability, Problem Diagnosis via System Logs, Monitoring and Accounting, security, Performance Models and Simulation, Introduction, new Performance issues, profit -effective parallel computing, impact of Heterogeneity and No dedication, Communication interactions, A cost model for effective parallel computing, the memory Hierarchy, Parallel Program structures, The cost model and memory access Time Prediction, Validation of the Framework and its Models.

UNIT – IV

Grid computing, Early grid Activities, data, computation, computational and Data grids, current grid activities, Overview of Grid Business Areas, Life sciences, Financial analysis and services, research collaboration, Engineering design, Collaborative games, Government, Grid applications, schedulers, resource broker, load balancing, grid portals, integrated solutions, grid infrastructure.

UNIT – V

Grid computing organizations and their roles, Organizations developing grid standards and best practice guidelines, Global Grid Forum(GGB), Organizations developing grid computing tool kits, Globus,Legion, Condor and Condor-G,Nimrod, UNICORE, NMI, Organizations building and grid-based solutions, Autonomic computing, Business on demand and Infrastructure Visualization, Service oriented architecture and Grid, Semantic grids.

UNIT – VI

Merging the grid services architecture with the web service architecture, Service-oriented architecture, Web Service Architecture, XML, Related Technologies, and Their Relevance to Web Services, XML Messages and Enveloping, SOAP, The SOAP processing model, SOAP Features, Message Exchange Pattern, SOAP Modules, Service Message Description Language (WSDL) The global XML Architecture vision, Service Policy, Policy Expression and Assertions, Security, Attaining Message Integrity, Some High –Level GXA Security Standards, Addressing (WS-Addressing), Relationship between Web Service and Grid Service, Interaction Aware State Information, Application Aware State Information, Web Service, interoperability ad the Role of the WS-I Organization. Introduction to Basic profile Guidelines, Some Details on the Basic Profile, with samples, WSDL Document Structure

UNIT - VII

Open Grid Services Architecture (OGSA, Introduction, OGSA Architecture and Goal, Some Sample Use Cases that Drive the OGSA, Commercial Data Centre, National Fusion collaboratory, Online Media and Entertainment, The OGSA Platform Components, Native platform Services and Transport Mechanism, OGSA Hosting Environment, Core Networking Services Transport and Security, OGSA Infrastructure, OGSA Basic Services.

UNIT - VIII

Open Grid Services Infrastructure (OGSI), introduction, Grid Services, A High-Level introduction to OGSI Specification, OGSI and its use of WSDL, Significance of Transforming GWSDL to WSDL Definition, Operator Overloading support in OGSI port Type, Introduction to Service Data Concepts, How to Declare Service Data with a port Type, Service Data Structure, How Mutability attributes Affect Service Data, Type of Service Data Elements and Service Data Values, The GWSDL Port Type Inheritance Affects the Service Data, Qualifying Service Data Element with Lifetime Attributes, Summary on OGSI-Defined Service Data Concepts, Grid Service:Naming and Change Management Recommendations, Grid Service Instance Handles, References, and Usage Models, Recommended GSR Encoding in WSDL, Life Cycle of a Grid Service Instance, Service Lifecycle Management Using a Soft-State Approach, Service Operation Extensibility Features of Grid Services, Service Fault Handling in OGSI, Grid Service Interfaces, Inside the Grid Service port type, Grid

Service – provided Service Data Query Capabilities: syntax and semantics, Grid Service – Provided Service Data Update Capabilities: syntax and semantics, Grid Service Factory Concepts, Grid Service Handle Resolution concepts, OGSI-Defined Grid Service Notification framework, Service Grouping Concepts in OGSI, Membership Rules for a Service Group, Service Entries in a service group, Service Group Entry, A Simple Registry Utilizing the OGSI Service Group Concepts, Grid Services and Client Programming Models, Grid Services and Service Programming Model

Text Books:

1. Joshy Joseph, Craig Fellenstein, *Grid computing*, Pearson Education, 2004

Suggested Books:

1. Ahmar Abbas, *Grid Computing, A Practical Guide to Technology and Applications*, Firewall media, 2004
2. Fran Berman, Geoffrey Fox, tony Hey, *Grid Computing, Making, The Global Infrastructure A Reality*, John Wiley & Sons Ltd, 2003
3. Rajkumar Buyya, *High performance Cluster Computing: Architectures and Systems*, vol,1,PHI,1999

Second Semester

INFORMATION RETRIEVAL SYSTEMS

UNIT I

Introduction: Definition, Objectives, Functional Overview, Relationship to DBMS, Digital libraries and Data Warehouses.

UNIT II

Information Retrieval System Capabilities: Search, Browse, Miscellaneous

UNIT III

Cataloging and Indexing: Objectives, Indexing Process, Automatic Indexing, Information Extraction.

UNIT IV

Data Structures: Introduction, Stemming Algorithms, Inverted file structures, N-gram data structure, PAT data structure, Signature file structure, Hypertext data structure.

UNIT V

Automatic Indexing: Classes of automatic indexing, Statistical indexing, Natural language, Concept indexing, Hypertext linkages

UNIT VI

Document and Term Clustering: Introduction, Thesaurus generation, Item clustering, Hierarchy of clusters.

UNIT VII

User Search Techniques: Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, Weighted searches of Boolean systems, Searching the Internet and hypertext.
Information Visualization: Introduction, Cognition and perception, Information visualization technologies.

UNIT VIII

Text Search Algorithms: Introduction, Software text search algorithms, Hardware text search systems.
Information System Evaluation: Introduction, Measures used in system evaluation, Measurement example, TREC results.

Text Book:

1. Kowalski, Gerald, Mark T Maybury: *Information Retrieval Systems:* Theory and Implementation, Kluwer Academic Press, 1997.

Reference Books

1. Frakes, W.B., Ricardo Baeza-Yates: *Information Retrieval Data Structures and Algorithms,* Prentice Hall, 1992.
2. Yates, *Modern Information Retrival,* Pearson Education.
3. Robert Korfhage, *Information Storage & Retieval,* John Wiley & Sons.

Second Semester

INFORMATION SECURITY

Unit 1: introduction: security goals, attacks, services and mechanism, techniques. Traditional symmetric key ciphers: Introduction, Substitution ciphers, Transposition ciphers, Stream and block ciphers.

Unit 2: Introduction to modern symmetric – key ciphers, Modern block ciphers, Modern stream ciphers. Data Encryption Standard (DES): Introduction, DES structure, DES analysis, Multiple DES, Security of DES. Enciphement using modern symmetric – key ciphers, Use of modern block ciphers, Use of stream ciphers, Other issues.

Unit 3: Advanced Encryption Standard (AES): Introduction, Transformations, Key expansion, Ciphers, Examples, Analysis of AES.

Unit 4: Mathematics of cryptography: Integer arithmetic, Modular arithmetic, Matrices, Linear congruence, Primes, Primality testing, Factorization, Chinese remainder theorem, Quadratic congruence, Exponentiation and logarithm.

Unit 5: Asymmetric – key cryptography: Rabin cryuptosystem, Elgamal cryptosystem, Elliptic curve cryptosystems. Message integrity and message authentication: Message integrity, Random oracle model, Message authentication

Unit 6: Cryptography hash functions: Introduction, SHA – 512, Whirlpool cipher.

Digital signature: Comparison, Process, Services, Attacks on digital signature, Digital signature schemes, Variations and applications. Entity authentication: Introduction, Passwords, Challenge – response, Zero – knowledge, Biometrics.

Unit 7: Key Management: Symmetric – key distribution, Kerberos, Symmetric – key agreement, Public key distribution. Network security: Security at the application layer: PGP and S/MIME: E-mail: PGP, S/MIME.

Unit 8: Security at the transport layer: SSL and TSL: SSL architecture, Four protocols, SSL message formats. Transport layer security: Security at the network layer: IPSec: Two modes, Two security protocols, Security association, Security policy, Internet key exchange (IKE), ISAKMP.

Text Book:

Cryptography and Network Security: Behrouz A. Forouzan, Tata McGraw-Hill publishing company limited, New Delhi.

Reference Books:

Cryptography and Network Security: William Stallings, Pearson Education.

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Second Semester

NEURAL NETWORKS
(ELECTIVE, III)

UNIT - I

Introduction and Learning Process: What is a neural network? Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Network Architectures, Knowledge representation, Artificial Intelligence and Neural Networks, Error Correction learning, Memory based learning, Hebbian learning, Competitive, Bolizmann learning, Credit Assignment problem, Memory, Adoption, Statistical nature of the learning process.

UNIT - II

Single Layer Perceptrons - Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square Filters, least mean squaT{) algorithm, learning carves, learning rate annealing techniques, perceptron-convergence theorem, Relation between perceptron and Bayes classifier for a Gaussian Environment.

UNIT - III

Multilayer Perceptron- Back propagation algorithm XOR problem, Heuristics, Output representation and decision rule, Comuter experiment, feature detection.

UNIT - IV

Back Propagation - back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.

UNIT - V

Self Organization maps - Two basic feature mapping models, self organization map, SOM algorithm, properties of feature map, computer simulations, learning vector quantization, Adaptive patter classification.

UNIT - VI

Neuro Dynamics - Dynamical systems, stability of equilibrium states, attractors, neurodynamical models, manipulations of attractors as a recurrent network paradigm

UNIT - VII

Hopfield Models- Hopfield models, computer experiment

UNIT – VIII

A Study of different algorithms on parallel implementations of back propagation networks.

TEXT BOOK:

1. Simon Hhaykin, *Neural Networks A comprehensive foundations,* PE 2nd Edition, 2004

REFERENCE BOOKS:

1. B.Vegnanarayana, *Artifical Neural networks* - Prentice Hall of India P Ltd 2005
2. Li Min Fu, *Neural networks in Computer intelligence* - TMH 2003
3. James a Freeman David MS Kapura, Neural networks – Pearson Education 2004

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Second Semester

PATTERN RECOGNIZATION
(ELECTIVE, III)

UNIT-I

Introduction: Machine perception, pattern recognition example, pattern recognition systems, the design cycle, learning and adaptation (Text book-1, p.nos: 1-17).

UNIT - II

Bayesian Decision Theory: Introduction, continuous features - two categories classifications, minimum error-rate classification- zero-one loss function, classifiers, discriminant functions, and decision surfaces (Text book-1, p.nos: 20-27, 29-31).

UNIT-III

Normal density: Univariate and multivariate density, discriminant functions for the normal density different cases, Bayes decision theory - discrete features, compound Bayesian decision theory and
context (Text book-1, p.nos: 31-45,51-54,62-63).

UNIT-IV

Maximum likelihood and Bayesian parameter estimation: Introduction, maximum likelihood estimation, Bayesian estimation, Bayesian parameter estimation-Gaussian case (Text book-1, p.nos: 84-97).

UNIT-V

Un-supervised learning and clustering: Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering. Date description and clustering - similarity measures, criteria function for clustering (Text book-1, p.nos: 517 - 526,537 - 546).

UNIT-VI

Component analyses: Principal component analysis, non-linear component analysis; Low dimensional representations and multi dimensional scaling (Text book-1, p.nos: 568-570,573 - 576,580-581).

UNIT-VII

Discrete Hidden Markov Models: Introduction, Discrete-time markov process, extensions to hidden Markov models, three basic problems for HMMs. (Text book -2, p.nos: 321 - 344)

UNIT-VIII

Continuous hidden Markov models: Observation densities, training and testing with continuous HMMs, types of HMMs. (Text book-2, p.nos: 348 - 352)

TEXT BOOKS:

1. Pattern classifications, Richard O. Duda, Peter E. Hart, David G. Stroke. Wiley student edition, Second Edition.
2. Fundamentals of speech Recognition, Lawerence Rabiner, Biing - Hwang Juang Pearson education.

REFERENCE:

1. Pattem Recognition and Image Analysis - Earl Gose, Richard John baugh, Steve Jost PHI 2004

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Second Semester

STORAGE AREA NETWORKS
(ELECTIVE, IV)

Unit 1. Introduction: What is a Storage Area Network? SAN components, SAN connectivity, SAN storage, SAN servers, The importance of standards, Where are SANs heading? Why use a SAN? The problem, The requirements, How can we use a SAN? Infrastructure simplification, Information lifecycle management, Business continuity, Using the SAN components, Storage, SAN connectivity, Servers, Putting the components together.

Unit 2. Fibre Channel internals: Why the Fibre Channel architecture? The SCSI legacy, Why Fibre Channel? Layers, Optical cables, Introduction to Storage Area Networks, Attenuation, Maximum power, Fiber in the SAN, Dark fiber, Classes of service, Class 1, Class 2, Class 3, Class 4, Class 5, Class 6, Class F, Fibre Channel data movement, Byte encoding schemes, Data transport, Ordered set, Frames, Sequences, Exchanges, In order and out of order, Latency, Open Fiber Control, Flow control, Buffer to buffer, End to end, Controlling the flow, Performance, Addressing, World Wide Name, Port address, 24-bit port address, Loop address, FICON address.

Unit 3. Topologies and other fabric services: Fibre Channel topologies, Point-to-point, Arbitrated loop, Switched fabric, Port types, Domain ID, Fibre Channel Arbitrated Loop protocols, Fairness algorithm, Loop addressing, Fibre Channel login, Port login, Process login, Fabric login, Fibre Channel fabric services, Management services, Time services, Simple name server, Login services, Registered State Change Notification, Routing mechanisms, Spanning tree, Fabric shortest path first, Zoning, Hardware zoning, Software zoning, LUN masking.

Unit 4. IP storage networking: Fibre Channel over IP, iFCP, iSCSI, The FCIP, iFCP or iSCSI conundrum, The multiprotocol environment, Fibre Channel switching, Fibre Channel routing, Tunneling, Routers and gateways, Internet Storage Name Service, FCIP, iFCP, iSCSI protocols, Routing considerations, Packet size, TCP congestion control, Round-trip delay, Write acceleration, Tape acceleration, Multiprotocol solution briefs, Dividing a fabric into sub-fabrics, Connecting a remote site over IP, Connecting hosts using iSCSI.

Unit 5. Fibre Channel products and technology: The environment, SAN devices, Bridges and gateways, Arbitrated loop hubs, Switched hubs, Switches and directors, Multiprotocol routing, Service modules, Multiplexers, Storage considered as legacy, Componentry, ASIC, Fibre Channel transmission rates, SerDes, Backplane and blades, Gigabit transport technology, Ten Gigabit small form-factor pluggable, Small form-factor pluggable media, Gigabit interface converters, Gigabit Link Modules, Media Interface Adapters, 1x9 Transceivers, Host bus adapters, Inter-switch links, Cascading, Hops, Fabric shortest path first, Blocking, Latency, Oversubscription, Congestion, Trunking.

Unit 6. Management: Management principles, Management types, SAN management levels, SAN fault isolation and troubleshooting, Management interfaces and protocols, SNIA initiative, Simple Network Management Protocol, Service Location Protocol, Vendor-specific mechanisms, Management features, IBM TotalStorage Productivity Center, Vendor management applications, IBM TotalStorage b-type family, Cisco, IBM TotalStorage e-type family, IBM TotalStorage m-type, family, SAN multipathing software, Storage virtualization in the SAN, SANs and storage, irtualization, Virtualization levels, Virtualization models, Virtualization strategies.

Unit 7. Security: Security principles, Access control, Auditing and accounting, Data security, Encryption, Encryption schemes, Encryption tools and systems, Security mechanisms, IP security, Fibre Channel security, Securing a fabric, Zoning, masking and binding, Data security, Best practices.

Unit 8. The IBM product portfolio: Why an IBM TotalStorage SAN? Entry SAN switches, IBM System Storage SAN10Q, IBM TotalStorage SAN16B-2, IBM TotalStorage SAN16M-2, Midrange SAN switches, IBM TotalStorage SAN32B-2, IBM System Storage SAN64B-2, IBM TotalStorage SAN32M-2.

Text Book: Jon Tate, Fabiano Lucchese, Richard Moore, *Introduction to Storage Area Networks,* IBM Press.

Reference Books:

Cris Beauchamp, Josh Judd, *Building SANs with Brocade,* Shroff Publishers & Distributors Pvt. Ltd.

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Second Semester

HIGH PERFORMANCE NETWORKS
(ELECTIVE IV)

UNIT – I

A Brief history, ARPANET, MINET, CSNET, NSFNET, ASNNET, The internet today, Protocols and Standards, Standards Organizations, Internet Administration, The OSI Model, Layers in the OSI Model, TCP/IP protocol Suite, Addressing, IP versions -4,5,6, Local Area networks, Point to Point Wans, Switched Wansn, Connecting Devices.

UNIT – II

IP addresses, Address space, Notation, Classful Addressing, Subnetting and Supernetting, Variable length Blocks, Subnetting, Address Allocations

UNIT – III

Delivery, Forwarding, and Routing, Structure of a Router, ARP, ARP Package, RARP.

UNIT – IV

Internet Protocal, Datagram, Fragmentation, Options, Checksum, IP Package, Inernet control Message protocol, Type of messages, message format, Error Reporting, Query, Checksum, Debugging Tools, ICMP Package.

UNIT – V

Internet Group Management Protocol, Group Management, IGMP messages, EGMP Operations, Encapusalation, IGMP Package, User Datagram Protocol, process to process communication, User Datagram, Checksum, UDP Operation, Use of UDP, UDP Package

UNIT - VI

Transmission Control Protocol, TCP Services, TCP Features, Segment, A TCP Connections, State Transition Diagram, Flow Control, Error Control, Congestion Control, TCP Timers, Options, TCP Package.

UNIT -- VII

Stream Control Transmission protocol, SCTP Services, SCTP Features, Packet Format, SCTP Association, Stat Transition Diagram, Flow Control, Error Control, Congestion Control.

UNIT – VIII

Unicast, Multicast and Broadcast, Domain name system, Name Space, Domain name space, Distribution of name space, DNS and Internet, File transfer protocol, Trivial file transfer protocol, World wide web Architecture, Next Generation IPv6, ICMP v6, Transmission from IPv4 to IP v6

TEXT BOOK:

1. Behrauz A.Forouzan – *TCP/IP Protocol Suite* – TMH, Third Edition, 2006

Second Semester

PARALLEL AND GRID COMPUTING LAB

Unit, 1
Parallel Computation with Mathematica: Requirements, Overview of Remote Execution, Simple Parallel Computations, Cleaning Up

Unit, 2
Starting Remote Kernels: MathLink Communication Modes, Remote Execution Options, Passive Connections, Configuring Parallel Computing Toolkit, Housekeeping, Resetting and Terminating Remote Kernels

Unit, 3
Parallel Evaluation: Sending Commands to Remote Kernels, Parallel Evaluation of Expressions

Unit, 4
Concurrency: Managing Parallel Processes, Processes and Processors, Starting and Waiting for Processes, Working with Process Ids

Unit, 5
Latency Hiding, Examples, The Scheduler

Unit - 6
Remote Definitions: Exporting Definitions, Loading Packages on Remote Kernels, Example: Eigenvalues of Matrices

Unit, 7
Virtual Shared Memory: Shared Memory versus Distributed Memory, Declaring Shared Variables, Synchronization

Unit, 8
Failure Recovery, Tracing, and Debugging: Failure of Remote Kernels, Tracing and Debugging, Aborting Parallel Programs