Nonlinear Data Structures **(30%)**

Trees: Definitions, terminologies and properties, Binary tree representation, traversals and applications, Threaded binary trees, Binary Search Trees, AVL Trees, M-way Search Trees, B-trees, B*-trees, B+-trees, Optimum binary search trees, Multidimensional binary search trees

Graphs: Graph representations; Graph Traversals

Priority Queues, Heap Structures, Binomial Heaps, Leftist Heaps

Complexity of Sort and Search Algorithms **(10%)**

Heap sort, Merge sort, Quick-sort, Hashing, General radix sort, Symbol tables, Sequential search, Binary search, Interpolation search, Tries

File organization and Processing **(25%)**

Sequential files: Organization, Creation, Update and Maintenance; Relative files: Organization, Hashing techniques: Approaches to collision problem, Creation, retrieval and update; Indexed sequential files: organization, Creation, Update and Maintenance, Multi-key files, Inverted file, Multi-list file, Alternate key, Tree structured files: B-trees, AVL-trees, Tries

Main Reading

1. J. B. Dixit, Mastering Data Structures Through C Language, First Edition, University Science Press, 2010
2. Richard F.Gilberg and Behrouz A.Forouzan Data Structure - A Pseudocode Approach with C -First Reprint -Thomson,2002

Supplementary Reading

1. Aho, Hopcroft, Ullman, Data Structures and Algorithms, Addison Wesley, 1983.
2. R. L. Kruse, Data Structures and Program Design, 3rd ed., Prentice-Hall, 1994.
3. Mary E. S. Loomis, Data Management and File Structures, 2nd ed., Prentice-Hall, 1989.
4. Clifford A. Shaffer, A practical Introduction to Data Structures and Algorithm Analysis, Prentice-Hall, 1997.
5. Kruse, Tondo and Leung, Data Structures and Program Design in C, 2nd edition, Prentice-Hall, 1997.

CS202 Operating Systems

Prerequisites: CS102 , PL105, PL106

Course contents:

Introduction **(4%)**

What Operation Systems Do, A brief history of Operating systems, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management , Storage Management, Protection and Security, Distributed Systems, Special-purpose Systems, Computing Environments

Systems Structures **(5%)**

Operating-systems Services, User Operating-system Interface ,System Calls, Types of System Calls, System Programs, Operating-System Design and implementation, Operating-system Structure, Virtual Machines, Operating-system generations, System Boot.

Process Management **(10 %)**

Process-Concept - Overview, Process Scheduling, Operations on Processes, Inter process Communication, Examples of IPC Systems, Communication in Client Server Systems.

Multithreaded Programming **(8%)**
Overview , Multithreading Models, Thread Libraries, Threading Issues, Operating system Examples

Process Scheduling **(8%)**
Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-processor scheduling, Thread scheduling, Operating-system Examples

Process Coordination **(12%)**
Synchronization - Background , The critical-section problem, Peterson's solution Synchronization Hardware, Semaphores, Classic problems of synchronization, Monitors, Synchronization Examples, Atomic Transaction

Deadlocks **(8%)**
System Model, Deadlock characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery From Deadlock

Memory Management **(10%)**
Memory-Management Strategies – Background, Swapping ,Contiguous Memory Allocation, Paging , Structure of the page table , Segmentation, Example: The Intel Pentium

Virtual-Memory Management **(10%)**
Background, Demand Paging, Copy-on-write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory, Other Considerations, Operating System Examples

File System **(15%)**
File Concept, Access Methods, Directory Structure, File-system mounting, File sharing, Protection ;Implementing File Systems - File-system Structure, File-system implementation, Directory implementation, Allocation Methods, Free-space Management, Efficiency and performance, Recovery, Log-structured file systems, NFS, Example: The WAFL File System

Secondary-storage Structure **(6%)**
Overview of Mass-storage Structure ,Disk Structure, Disk Attachment ,Disk Scheduling ,Disk Management,Swap-Space Management ,RAID Structure, Stable-storage implementation,Tertiary-storage structure; I/O Systems -Overview, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O requests to hardware operations, STREAMS, Performance

Distributed Systems **(4%)**
Distributed Operating Systems – Motivation, Types of Distributed Operating Systems, Network Structure , Network Topology ,Communication Structure, Communication Protocols, Robustness , Design Issues; Distributed File Systems - Background, Naming and Transparency, Remote File Access ,Stateful Versus Stateless Service. An Example: AFS

Main Reading

1. Operating systems Principles – Silberschatz ,Galvin and Gagne - 7th edition (Wiley Asia Student Edition)

Supplementary Reading

1. Deitel H.M., "An Introduction to Operating Systems", Addison Wesley Publishers Company, 1994
2. Milenkovic M., "Operating Systems : Concepts and Design", McGraw Hill International Edition Computer Science series 1992.
3. Tanenbaum A. S., Modern Operating Systems", Prentice Hall of India Pvt. Ltd., 1995
4. Operating Systems – a modern perspective - Gary Nutt , Addison Wesley