Computer System Fundamentals (RCP23DCPC301)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite: Basic Mathematics

Course Objectives:

To understand the structure, functions and characteristics of computer system and operating systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental organization of a computer system.	L1	Remember
CO2	Apply appropriate memory mapping, process scheduling and disk scheduling methods.	L3	Apply
CO3	Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.	L3	Apply
CO4	Differentiate between various processor architecture.	L4	Analyze

Unit-I 08 Hrs.

Introduction to System Fundamentals: Realization of half adder and full adder using Logic Gates, Von Neumann model, Fixed point representation, Register Transfer and Micro-operations: Floating point representation, Arithmetic MicroOperations, Arithmetic logical shift unit. Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations, Instruction Cycle with interrupt and DMA. Operating System Architecture: Basic functions and services, System calls, Types of Operating Systems: Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real-time O.S.

Unit-II 06 Hrs.

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC). Process Management: Process Concept, Process states, Process control Block, Threads, Uniprocessor Scheduling: Types of scheduling: Pre-emptive, non-preemptive, Scheduling algorithms: FCFS, SJF, RR, Priority. Comparative study of process management in Windows, Linux and Android OS.

Unit-III 08 Hrs.

Memory Organization: Memory Hierarchy, Main Memory, Cache Memory, Memory Mapping, cache coherence, Pentium IV cache organization, ARM cache organization. Memory Management: Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, Virtual Memory, Paging. Segmentation, Demand paging and Page replacement policies. Comparative study of memory management in Windows, Linux and Android OS.

Unit-IV 09 Hrs.

Concurrency control: Concurrency: Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer Consumer problems and solutions. Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher problem. Comparative study of concurrency control in Windows, Linux and Android OS.

Unit-V **04 Hrs.**

File and I/O management: File access methods, I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache, Arbitration methods, Comparative study of file and I/O management in Windows, Linux and Android OS.

Unit-VI **04 Hrs.**

Advance Computer Architecture: Characteristics of Multiprocessors, Flynn's taxonomy, Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Introduction to Multiprocessor network topologies.

Text Books:

1. William Stallings,"Computer Organisation and Architecture", Pearson publication, 11^{th} Edition, 2018.

2. Greg Gagne, Abraham Silberschatz, John Wiley & Sons, Inc. "Operating System Concepts", 10^{th} Edition, 2018.

Reference Books:

1. John Hayes, "Computer Architecture and Organization", McGrawHill, 3^{rd} Edition, 2017.

2. M. Morris Mano, "Computer System Architecture", Pearson, 2017.

3. Andrew S. Tanenbaum and Todd Austin, "Structured Computer Organization", 6^{th} Edition, PHI, 2016.

4. M. Murdocca & V. Heuring, "Computer Architecture & Organization", WILEY, 2017.

5. By Andrew S. Tanenbaum, "Modern Operating Systems", PHI, 2009.

6. G. Meike, Lawrence Schiefer, "Inside the Android OS: Building, Customizing, Managing and Operating Android System Services (Android Deep Dive)", 2021.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Suggested Experiments:

- Implement Booth's multiplication algorithm.
- Implement CPU Non-Preemptive scheduling algorithms like FCFS, SJF, Priority etc.
- Implement CPU Preemptive scheduling algorithms like SRTF, Round Robin, Preemptive priority etc.
- Explore the internal commands of Linux.
- Write shell scripts handling File, Directory, Networking and security aspects.
- Implement Best Fit, First Fit and Worst Fit Memory allocation policy.
- Implement Fully associative and set associative cache memory mapping.
- Implement various cache/page replacement policies.
- Implement order scheduling in supply chain using Banker's Algorithm.
- Implement Disk Scheduling Algorithms.

  Study Experiments:

  - Implement Restoring and Non-Restoring division algorithm.
  - Implement Solution to Producer Consumer Problem of Process Synchronization.
  - Implement Solution to Reader Writer Problem of Process Synchronization.
  - Implement Solution to Dinning Philosopher Problem of Process Synchronization.
  - Implementation of Multithreading using parent process and child process using UNIX calls like fork, exec and wait.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.