First Semester

Object Oriented Programming with C++ (MCA-111)

Professional Core (PC); 4 Credits (3-0-2)

Objectives:

The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests..

Unit	Contents	No. of Lectures
Unit 1	Detailed contents Abstract data types and their specification	**06**
Unit 2	How to implement an ADT. Concrete state space, concrete invariant, abstraction	**12**
Unit 3	Detailed function. Implementing operations, illustrated by the Text example. Features of object	**05**
Unit 4	Features of object-oriented programming. Encapsulation, object identity, polymorphism, Inheritance in OO design.	**06**
Unit 5	Design patterns. Introduction and classification. The iterator pattern. Model-view-controller pattern.	**06**
Unit 6	Implementing OO language features. Commands as methods and as objects.	**06**
Unit 7	Memory management. Generic types and collections. The software development GUIs. Graphical programming with Scala and Swing process.	**08**
		49

Reference/Text Books :

1. Herbert Schildt, "C++ the Complete Reference ", III edition, TMH 1999
2. Balagurusamy, Entrepreneurial "Object Oriented programming with C++", TMH

3. Barkakatin “objects oriented programming in C++” PHI 1995
4. Barbara Liskov, Program Development in Java, Addison-Wesley, 2001

Data Structures and Indexing (MCA-112)
Professional Core (PC); 4 Credits (3-0-2)

Objectives:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures.

Unit	Contents	No. of Lectures
Unit 1	**Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	**09**
Unit 2	**Stacks and Queues:** ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	**12**
Unit 3	**Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of **Trees:** Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.	**12**
	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort;	

Unit 4	Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	**12**
		45

Reference/Text Books

1. Horowitz and Sahani, "Fundamentals of data Structures", Galgotia Publication Pvt. Ltd., New Delhi.
2. M. Tenenbaum, "Data Structures using C and C++", Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Schaum's Outlines Data structure Seymour Lipschutz Tata McGraw Hill 2nd Edition

Real Time Operating System (MCA-113)
Professional Core (PC); 4 Credits (3-1-0)

Objectives:

To learn the fundamentals of Operating Systems:

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management
5. To learn to implement simple OS mechanisms

Unit	Contents	No. of Lectures
Unit1	**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS- Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	**04**
Unit2	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread:	**04**

	Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process **Scheduling:** Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; **Scheduling algorithms:** Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	
Unit3	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.	**12**
Unit4	**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	**08**
Unit5	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. **Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	**08**
Unit6	**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms **File Management:** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. **Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	**12**
		48

Reference/Text Books:

1. Operating Systems Design and implementation Andrew S. Tanenbam, Albert S. Woodhull Pearson
2. Operating System Concepts (7th Ed) by silberschatz and Galvin, Wiley, 2000.
   Operating Systems (5th Ed) - Internals and Design Principles by William Stallings, Prentice Hall, 2000 4.Unix Shell Programming - YashwantKanetkar, BPB publications.

Computer Organization and Architecture (MCA-114)
Professional Core (PC); 4 Credits (3-1-0)

Objectives:

To expose the students to the following:

1. How Computer Systems work & the basic principles
2. Instruction Level Architecture and Instruction Execution
3. The current state of art in memory system design
4. How I/O devices are accessed and its principles.
5. To provide the knowledge on Instruction Level Parallelism
6. To impart the knowledge on micro programming
7. Concepts of advanced pipelining techniques.

Unit	Contents	No. of Lectures
Unit 1	**Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs. **Data representation:** signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-andadd, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.	15
	Introduction to x86 architecture. CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple	

Unit 2	hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB	**20**
Unit 3	**Pipelining**: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.	**10**
Unit 4	**Memory organization:** Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.	**10**
		55

Reference/Text Books:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, 5th Edition "Computer Organization", McGraw-Hill, 2002.
2. Ghosh T.K, "Computer Organization and Architecture", Tata McGraw-Hill,2011.
3. Computer System Architecture –Third Edition-by M. Morris Mano.
4. William Stallings, "Computer Organization and Architecture – Designing for performance", 7th Edition, Pearson Education, 2006.
5. Behroozparahami, "Computer Architecture"Oxford University Press-Eighth Impression, 2011.

   David A. Patterson and John Hennessy L, "Computer Architecture-AQuantitative Approach", Fifth edition, Elsevier, a division of reed India Private Limited, 2012.

Mathematical Foundations for Computer Science (MCA-115)

Professional Core (PC); 4 Credits (3-1-0)

Objectives:

To expose the students to the following:

1. To understand the basics of Mathematics which use in computer science.
2. To understand discrete mathematics.
3. To understand the representation.

Unit	Contents	No. of Lectures
Unit 1	**Mathematical Logic:** Propositional Calculus: Statements and Notations, Connectives, Well-Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications.	**10**
Unit 2	**Set Theory:** Introduction, Operations on Binary Sets, Principle of Inclusion and Exclusion, Relations: Properties of Binary Relations, Relation Matrix and Digraph, Operations on Relations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering Relations, Hasse Diagrams, Functions: Bijective Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions, Lattice and its Properties	**16**
Unit 3	**Combinatorics:** Basic of Counting, Permutations, Permutations with Repetitions, Circular Permutations, Restricted Permutations, Combinations, Restricted Combinations, Generating Functions of Permutations and Combinations.	**12**
Unit 4	**Graph Theory:** Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Planar Graphs, Euler‘s Formula.	**12**
		50

Reference/Text Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, 3th Edition “Discrete Mathematical Structures”, Prantice Hall, 1996.
2. Kenneth Rosen, 7th Edition “Discrete Mathematics and its applications”, Tata McGraw-Hill, 1986.