# Maulana Abul Kalam Azad University of Technology, WB
## (Formerly known as West Bengal University of Technology)
## Syllabus of B.Sc. in Computer Science
## Effective from academic session 2023-24

### Semester-I

**Paper Name: Programming Fundamentals – using C Language/Programming using C Lab**

**Code: CS 101 / CS 191**
**Contact: 3L+ 2P**

**Course Objectives:**

1. To analyze a new problem
2. Learn to design algorithm for the problem
3. Logical implementation of problems
4. Implement steps of algorithms through programming in C
5. Learn basic input and output method through high level programming
6. Conditional statement management
7. Loop concepts
8. Learn function management
9. Input and output through files

**Module** 1: Introduction to Principles of programming
Introduction to Programming , Programing Domain : Scientific Application , Business Applications, Artificial Intelligence, Systems Programming , Web Software Categories of Programming Languages: Machine Level Languages, Assembly Level Languages , High Level Languages Programming Design Methodologies : Top Down and Bottom UP Program Development Cycle with case study, Program Execution and Translation Process ,Problem solving using Algorithms and Flowcharts, Performance Analysis and Measurements: Time and Space complexity

**Module** 2: Introduction to C Programming:
Features of C and its Basic Structure, Simple C programs, Constants, Integer Constants, Real Constants, Character Constants, String Constants, Backslash Character Constants, Concept of an Integer and Variable, Rules for naming Variables and assigning values to variables

**Module** 3: Operators and Expressions:
Arithmetic Operators, Unary Operators, Relational and Logical Operators, The Conditional Operator, Library Functions, Bitwise Operators, The Increment and Decrement Operators, The Size of Operator, Precedence of operators.

**Module** 4: Data Types and Input/Output Operators:
Floating-point Numbers, Converting Integers to Floating-point and vice-versa, Mixed-mode Expressions, The type cast Operator, The type char, Keywords, Character Input and Output, Formatted input and output, The gets() and puts() functions, Interactive Programming.

**Module** 5 : Control Statements and Decision Making:
The goto statement, The if statement, The if-else statement, Nesting of if statements, The conditional expression, The switch statement, The while loop, The do…while loop, The for loop, The nesting of for loops, The break statement and continue statement.

**Module** 6 : Arrays and Strings:

One Dimensional Arrays, Passing Arrays to Functions, Multidimensional Arrays, Strings

**Module** 7: Pointers – I:

Basics of Pointers, Pointers and One-dimensional Arrays, Pointer Arithmetic, Pointer Subtraction and Comparison, Similarities between Pointers and One-dimensional Arrays.

**Module** 8: Pointers – II:

Null pointers, Pointers and Strings, Pointers and two-dimensional arrays, Arrays of Pointers

**Module** 9: Structures and Unions:

Basics of Structures, Arrays of Structures, Pointers to Structures, Self-referential Structures, Unions

**Module** 10: Functions:

Function Philosophy, Function Basics, Function Prototypes, and Passing Parameters: Passing Parameter by value and Passing Parameter by reference, passing string to function, Passing array to function, Structures and Functions Recursion

**Module** 11: Storage Classes:

Storage Classes and Visibility, Automatic or local variables, Global variables, Static variables, External variables

**Module** 12: The Preprocessor:

File Inclusion, Macro Definition and Substitution, Macros with Arguments, Nesting of Macros, Conditional Compilation

**Module** 13: Dynamic Memory Allocation and Linked List:
Dynamic Memory Allocation, Allocating Memory with malloc, Allocating Memory with calloc, Freeing Memory, Reallocating Memory Blocks, Pointer Safety, The Concept of linked list, Inserting a node by using Recursive Programs, Sorting and Reversing a Linked List, Deleting the Specified Node in a Singly Linked List.

**Module** 14: File Management:

Defining and Opening a file, Closing Files, Input/output Operations on Files, Predefined Streams, Error Handling during I/O Operations, Random Access to Files, Command Line Arguments.

**Reference Books:**

1. Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Co.
2. Programming with C, Gottfried, TMH
3. Let us C, Yashavant P. Kanetkar, BBP Publications, Delhi
4. Programming in ANSI C by E Balagurusamy, TMH
5. Problem Solving & Programming in C by R.S. Salaria, Khanna Publishing House

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**Paper Name: Digital Electronics / Digital Electronics Lab**

**Code: CS 102 /CS 192**

**Contact: 3L+2P**

**Course Objectives**

The objectives are to study

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.

2. To prepare students to perform the analysis and design of various digital electronic circuits.

**Course Outcomes**

After studying this course the students would gain enough knowledge

1. Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.

2. To understand and examine the structure of various number systems and its application in digital design.

3. The ability to understand, analyze and design various combinational and sequential circuits.

4. Ability to identify basic requirements for a design application and propose a cost effective solution.

5. The ability to identify and prevent various hazards and timing problems in a digital design.

6. To develop skill to build, and troubleshoot digital circuits.

**Module** 1: BINARY SYSTEMS: Digital Systems, Binary Numbers, Number base conversions, Octal and Hexadecimal Numbers, complements, Signed binary numbers, Binary codes, Binary Storage and Registers, Binary logic.

**Module** 2: BOOLEAN ALGEBRA AND LOGIC GATES : Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and properties of Boolean algebra, Boolean functions canonical and standard forms, other logic operations, Digital logic gages, integrated circuits.

**Module** 3: GATE – LEVEL MINIMIZATION: The map method, Four-variable map, Five-Variablemap, product of sums simplification Don't-care conditions, NAND and NOR implementation other Two-level implementnations, Exclusive – Or function, Hardward Description language (HDL).

**Module** 4: COMBINATIONAL LOGIC : Combinational Circuits, Analysis procedure Design procedure, Binary Adder-Subtractor Decimal Adder, Binary multiplier, magnitude comparator, Decoders, Encoders, Multiplexers, HDL for combinational circuits.

**Module** 5: SYNCHRONOUS SEQUENTIAL LOGIC: Sequential circuits, latches, Flip-

Flops Analysis

of clocked sequential circuits, HDL for sequential circuits, State Reduction and Assignment, Design Procedure

**Module** 6: Registers, shift Registers, Ripple counters synchronous counters, other counters, HDL for
Registers and counters.

**Module** 7: Introduction, Random-Access Memory, Memory Decoding, Error Detection and correction
Read-only memory, Programmable logic Array programmable Array logic, Sequential Programmable Devices.

**Module** 8: ASYNCHRONOUS SEQUENTIAL LOGIC : Introduction, Analysis Procedure, Circuits
with Latches, Design Procedure, Reduction of state and Flow Tables, Race-Free state Assignment Hazards, Design Example.

**Laboratory**
**Combinational Circuits:**

1. Implementation of different functions using Basic and Logic gates, SOP, POS
2. Study and prove De-Morgan's Theorem.
3. Universal function using NAND and NOR gates
4. Implementation of half and Full adder (3-bit) using basic logic gates and Universal logic gates (NAND & NOR).
5. Implementation of half and Full Subtractor (3-bit) using basic logic gates and Universal logic gates (NAND &NOR).
6. 1 Digit BCD adder using 7483 and other logic gates.
7. Design 4 to 1 multiplexer using logic/Universal gates and implement full adder/full subtractor.
8. Using 74153 and 74151 to implement full adder/ full subtractor and other functions.
9. Cascading of Multiplexers.
10. Design 2 to 4 decoder using basic / universal logic gates.
11. Study 74138 and 74139 and implement full adder / full subtractor and other functions.
12. Implementation of 1 bit Comparator using decoders.
13. Cascading of Decoders.
14. Design a parity generator and checker using basic gates.
15. Construct and study comparators using 7485.
16. Construct Comparator (2-bit) using logic gates
17. Design a seven segment display unit using Common anode/Common cathode and 7447 / 7448.
18. Study Priority Encoder Chip 74147/74148.

**Text/Reference Books**

1. DIGITAL DESIGN – Third Edition , M.Morris Mano, Pearson Education/P
2. Analog Electronics, A.K. Maini, Khanna Book Publishing.
3. Design of Analog Circuits, A.V.N. Tilak, Khanna Book Publishing.
4. Digital Circuits, Vol - I & II, D. Ray Chaudhuri, Platinum Publishers.
5. Digital Systems - Principle & Applications, Tocci & Widmer, EEE

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**Semester-II**

**Paper Name: Data Structures and Data Structures Lab**

**Code: CS 201 / CS 291**

**Contact: 3L+2P**

**Course Objectives:**

CO1. To understand and identify the different types of data.
CO2. To understand the pointers, structures and self-referential structure. CO3. To learn the implementation of different types of memory allocation.CO4. To learn File Management and the application.
CO5. To understand the implementation of Data Structure using Array.
CO6. To gain the proper knowledge of sorting, searching of data and their complexity analysis.CO7. To understand the implementation of Linked list.
CO8. To understand the concept of tree and their different implementations.CO9. To understand the graphs and their operations.
CO10.To learn the hash functions and their different functionalities.

**Course Outcomes:**
1 Ability to understand the basic structures of data
2 Ability to understand and use of the pointer, Self-referential structure
3 Ability to understand static and dynamic memory allocation in memory using malloc(),calloc(),realloc(), free().4 Ability to understand File Management and the application using differentfunctions.
5 Ability to use and implement Data Structure using Array6 Ability to do different types of Searching and Sorting
7. Ability to implement different types of Linked List
8. Ability to grasp the concept of different types of tree and theirimplementations.
9. Ability to understand of different types of graphs and their operations.
10. Ability to understand of Hashing and their different functionalities.

**Module I: Concepts of Abstract data type**
Concept of abstract data types, Structure, union, enum, pointer to structure, Self referential structure, Pointer to pointer 2.

**Module II: Dynamic Memory Allocation**
Difference between static and dynamic memory allocation, Using functions such as malloc(), calloc(), realloc(), free().

**Module III:** File Management (4L) Application of functions such as fopen(), fclose(), getc(), putc(), fprintf(), fscanf(),getw(), putw(), command line argument

**Module IV: Data Structure using Array**
Stack, queue, circular queue, priority queue, dequeue and their operations and applications.

**Module V: Searching and Sorting**
Searching: linear search, Binary search, their comparison, sorting: insertion sort, Selection sort. Quick sort, Bubble sort Heap sort, Comparison of sorting methods, Analysis of algorithm, complexity using big 'O' notation

**Module VI: Linked List**

Linear link lists, doubly linked lists, stack using linked list, queue using linked list, circular linked list and their operationsand applications.

**Module VII: Trees**

Binary trees, binary search trees, representations and operations, thread representations, sequential representations, Btree, B+ tree,

**Module VIII: Graphs**

Introduction to graphs, Definition, Terminology, Directed, Undirected & Weighted graph, Representation of graphs, Graph Traversal: Depth first search and Breadth first search. Spanning Trees, minimum spanning Tree, Shortest path algorithm

**Reference Books:**

1. Expert Data Structures with C, R.B. Patel, Khanna Publishing House
2. Mastering Algorithms with C,Loudon,SPD/O'REILLY
3. Data Structure Using C & C++, Tannenbaum, PHI
4. C and Data Structure, Radhaganesan, Scitech
5. Data Structures in C, Ajay Agarwal, CyberTech
6. Data Structures Using C, Radhakrishnan&Shrinivasan, ISTE/EXCEL BOOKS

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**Computer Organization**

**Code: CS 202**

**Contacts: 3L**

**Course Outcomes:**

CO1. Identify functional units and illustrate register transfer operations.

CO2. Manipulate representations of numbers stored in digital computers.

CO3. Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory

CO4. Make use of fixed- and floating-point algorithms and analyze micro program instructions.

CO5. Summarize the memory organization and pipelining concepts.

| Unit | Content |
|---|---|
| 1 | Data Representation:<br><br>1. Number Systems – decimal, binary, octal, hexadecimal, alphanumeric representation, 2. Complements – 1's complement, 2' complement, 9's complement, 10' complement, (r-1)'s complement, r's complement, 3. Fixed point representation – Integer representation, arithmetic addition, arithmetic subtraction, overflow, decimal fixed-point representation, 4. Floating point representation, 5. IEEE 754 floating point representation |
| 2 | Computer arithmetic:<br><br>1. Addition algorithm of sign magnitude numbers, 2. Subtraction algorithm of sign magnitude numbers, 3. Addition algorithm of signed 2's complement data, . Subtraction algorithm of signed 2's complement data, 5. Multiplicationalgorithm,<br><br>Booth's algorithm, 6. Division algorithm |
| 3 | Register transfer and micro-operations:<br><br>1. Register transfer language, 2. Register transfer, 3. Bus system for registers, 4. Memory transfers – memory read, memory write, 5. Micro operations – register transfer micro-operations, arithmetic micro-operations, logic micro operations, shift micro operations, 6. Binary adder, binary adder subtractor, binary incrementer, arithmetic circuit for arithmetic micro operations, 7. One stage logic circuit, 8. Selective set, Selective complement, Selective clear, Mask, Insert, Clear |
| 4 | Basic Computer organization and design:<br><br>1. Instruction codes, 2. Direct address, Indirect address & Effective address, 3. List of |

basic computer registers, 4. Computer instructions: memory reference, register reference & input – output instructions, 5. Block diagram & brief idea of control unit of basic computer, 6. Instruction cycle

5 Micro programmed control:

1.Control memory, 2. Address sequencing, 3. Micro program examples

6 Central processing unit:

1. General register organization, 2. Stack organization, Register stack, Memory stack,

Stack operations –push & pop, 3. Evaluation of arithmetic expression using stack,

4. Instruction format, 5. Types of CPU organization (single accumulator, general register& stack organization) & example of their instructions, 6. Three, two, one & zero address instruction, 7. Definition and example of data transfer, data manipulation & program control instructions

7 Pipeline and vector processing:

1.Parallel processing, 2. Flynn's classification, 3. Pipelining, Example of pipeline, space time diagram, speedup, 4. Basic idea of arithmetic pipeline, example of floating-point addition/ subtraction using pipeline

8 Input – output organization:

2. Peripheral devices, 2. Input – output interface, 3. Isolated I/O, Memory mapped I/O, 4. Asynchronous data transfer: strobe & handshaking, 5. Programmed I/O, 6. Interrupt initiated I/O, 7. Basic idea of DMA & DMAC 8. Input – output processor

9 Memory organization:

3. Memory hierarchy, 2. Main memory definition, types of main memory, types of RAM, ROM, difference between SRAM & DRAM, 3. Cache memory, Cache memory mapping – Direct, Associative, Set Associative, 4. CAM, hardware organization of CAM, 5. Virtual memory, mapping using pages, page fault, mapping using segments, TLB, 6. Auxiliary memory, diagrammatic representation of magnetic disk & hard disk drive, 7. Definitions of seek time, rotational delay, access time, transfer time, latency

**Text book and Reference books:**

1. Computer System Architecture, M. Morris Mano, PEARSON
2. Computer Organization & Architecture – Designing For Performance, William Stallings,PEARSONReference Book
1. Computer Architecture &Organisation, J.P. Hayes, TATA MCGRAW HILL
2. Computer Organization and Architecture, T. K. Ghosh, TATA MCGRAW-HILL
3. Computer Architecture, BehroozParhami, OXFORD UNIVERSITY PRESSReferences: Boris Beizer, SoftwareTesting Techniques, Dreamtech, 2009

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**Computer Organization Lab**

**Code: CS 292**

**Contacts: 2P**

**List of Laboratory Experiments:**

1. HDL introduction.
2. Basic digital logic base programming with HDL
3. 8-bit Addition, Multiplication, Division
4. 8-bit Register design
5. Memory unit design (24x8 (16 byte)) and perform memory operations.
6. 8-bit simple ALU design
7. 8-bit simple CPU design
8. Interfacing of CPU and Memory.
9. Any experiment specially designed by the college

**Text & Reference books:**


1. Circuit Design and Simulation with VHDL, By Volnei A. Pedroni · 2010, MIT Press.
2. VHDL Programming by Example By Douglas L. Perry · 2002, McGraw-Hill Education