

Contents

CHAPTER 1 INTRODUCTION TO C	1
1.1 Overview of C	1
1.1.1 Introduction	1
1.1.2 Importance of C language	1
1.1.3 Basic structure of C program	2
1.1.4 Programming style	4
1.1.5 Sample C program	4
1.2 Constants, Variables and Data types	6
1.2.1 Introduction	6
1.2.2 Character set	7
1.2.3 C tokens	8
1.3 Data types	11
1.4 Declaration of variables	13
1.5 Managing I/O operations	17
1.5.1 Introduction	17
1.5.2 Unformatted character reading	17
1.5.3 Formatted I/O	19
1.6 Operators and expressions	23
1.6.1 Introduction	23
1.6.2 Arithmetic operators	23
1.6.3 Increment and Decrement operators	25
1.6.4 Relational operators	26

1.6.5	Logical operators	27
1.6.6	Assignment operators	27
1.6.7	Conditional operators	28
1.6.8	Comma operator	28
1.6.9	Bit-wise operators	29
1.6.10	Cast operator	30
1.6.11	<i>sizeof</i> operator	30
1.6.12	Arithmetic expression	31
1.6.13	Operator precedence	32
1.6.14	Type conversion	32
1.7	Decision making, branching, and looping	35
1.7.1	Introduction	35
1.7.2	The if statement	35
1.7.3	The if-else statement	38
1.7.4	Nested if-else statement	39
1.7.5	The switch statement	39
1.7.6	The ?: operator	41
1.7.7	The goto statement	42
1.7.8	The while loop	42
1.7.9	The do-while loop	44
1.7.10	The for statement	44
1.7.11	The break and continue statement	46
1.8	Arrays	49
1.8.1	Introduction	49
1.8.2	One-dimensional arrays	49
1.8.3	Two-dimensional arrays	52
1.8.4	Initializing two-dimensional arrays	53
1.9	User defined functions	54
1.9.1	Introduction	54
1.9.2	Advantages of using functions	54
1.9.3	Functions and Multi-functions	55
1.9.4	Return values and their types	56
1.10	Structures	60
1.10.1	Introduction	60
1.10.2	Accessing structure members	61
1.10.3	Initializing a structure	62
1.10.4	Arrays of structures	62
1.10.5	Structures and functions	62
1.10.6	<i>sizeof</i> of a structure	63
1.10.7	Union	63

1.10.8 Structure assignment comparison	64
1.11 Pointers	64
1.11.1 Introduction	65
1.11.2 Understanding pointers	65
1.11.3 Declaring and initializing pointer variable	65
1.11.4 Accessing pointer variables	66
1.11.5 Pointer arithmetic	68
1.11.6 Pointers and arrays	70
1.11.7 Character pointers	71
1.11.8 Pointers and functions	71
1.11.9 Pointers and structures	73
1.11.10 Pointers and functions	75
1.12 Dynamic Memory Allocation	77
1.12.1 <i>malloc()</i> Function	78
1.12.2 <i>calloc()</i> Function	79
1.12.3 <i>realloc()</i> Function	81
1.12.4 <i>free()</i> function	82
1.13 File Management	82
1.13.1 <i>fopen()</i> Function	84
1.13.2 <i>fclose()</i> Function	85
1.13.3 Stream Functions – "r" mode	86
1.13.4 Stream Functions – "w" mode	89
1.13.5 Stream Functions – "a" mode	90
1.13.6 Binary I/O – <i>fread()</i> & <i>fwrite()</i>	91
1.13.7 Formatted I/O – <i>fscanf()</i> & <i>fprintf()</i>	94
1.13.8 Additional Examples	95
1.13.9 Random Access – <i>fseek()</i>	96
1.13.10 <i>ftell()</i> Function	98
1.13.11 Error handling – <i>ferror()</i> & <i>perror()</i>	100
1.14 Command Line Arguments	102
1.15 Summary	106
1.16 Exercises	107

CHAPTER 2 INTRODUCTION TO DATA STRUCTURES

2.1 Introduction	109
2.2 Data object	109
2.3 Data type	110
2.4 Primitive data structures	110
2.5 Abstract data type (ADT)	111
2.6 Arrays	112

6.8	Stack as a linked list	211
6.8.1	Push() and Pop() functions	211
6.9	Queue as a linked list	212
6.9.1	Queue insertion and deletion	213
6.10	Double ended queue (deque)	214
6.11	Ordered linked list	216
6.12	Examples on singly linked list	218
6.13	A comparison between Arrays and linked list	225
6.14	Circular linked list	226
6.14.1	Creating a circular list (front insertion)	227
6.14.2	Inserting a node in a circular list	228
6.14.3	Deleting a node in a circular list	230
6.14.4	Displaying a circular list	232
6.15	Stack as a Circular list	233
6.16	Queue as a Circular list	235
6.17	Circular list with a header node	237
6.18	Doubly linked list	239
6.18.1	Creating a doubly linked list	239
6.18.2	Inserting a node before a key node	241
6.18.3	Deleting a node	242
6.19	Applications	244
6.19.1	Polynomial addition	244
6.19.2	Adding two long positive integers	251
6.20	Linked list with arrays	255
6.21	Summary	257
6.22	Exercises	257

CHAPTER 7 TREES		259
7.1	Introduction	259
7.2	General trees	260
7.3	Binary trees	262
7.4	Properties of binary trees	264
7.5	Representation of binary trees	265
7.6	Tree traversal methods	266
7.6.1	Algorithms and examples	267
7.6.2	From preorder and inorder to binary tree	270
7.7	Binary tree operations and its ADT	271
7.8	Implementation of binary trees	272
7.8.1	Binary Search Tree (BST)	272

7.8.2	Building a BST	273
7.8.3	tree traversals	275
7.8.4	Search	276
7.8.5	Height	277
7.8.6	Size	278
7.8.7	Leaf nodes	278
7.8.8	Finding a min element	279
7.8.9	Copy	280
7.8.10	Delete	281
7.9	Implicit array representation of binary trees	285
7.9.1	MakeTree()	287
7.9.2	Display()	288
7.10	Priority queues using a heap	289
7.10.1	Heaps	289
7.10.2	Initial heap construction	290
7.10.3	Insertion in MaxHeap	293
7.10.4	Deletion from a MaxHeap	295
7.11	Threaded binary trees	296
7.12	Summary	298
7.13	Exercises	300
 CHAPTER 8 SORTING		301
8.1	Introduction	301
8.2	Space and Time complexity	302
8.3	Asymptotic notations	303
8.3.1	Big Oh Notation	304
8.3.2	Omega Notation	305
8.3.3	Theta Notation	306
8.4	Bubble Sort	306
8.5	Quick Sort	309
8.5.1	An Example	310
8.6	Merge Sort	313
8.6.1	The Method	314
8.7	Heap Sort	317
8.8	Selection Sort	320
8.9	Insertion Sort	321
8.10	Shell Sort	322
8.11	Address Calculation Sort	325
8.12	Radix Sort	329

8.13 Summary	334
8.14 Exercises	335
CHAPTER 9 SEARCHING	337
9.1 Introduction	337
9.2 Linear Search	338
9.2.1 Recursive Linear Search	339
9.3 Binary Search	340
9.3.1 Recursive Binary search	342
9.4 Interpolation Search	343
9.5 Hashing	345
9.5.1 Hash functions	346
9.5.2 Collision resolution techniques	347
9.6 Summary	352
9.7 Exercises	352
CHAPTER 10 'C' LAB PROGRAMS	353
10.1 Student records – sequential file	353
10.2 Stack	356
10.3 Infix to Suffix conversion	358
10.4 Postfix expression evaluation	361
10.5 Queue	363
10.6 Circular Queue	365
10.7 Priority Queue	368
10.8 Singly linked list	371
10.9 Stack as linked list	377
10.10 Queue as linked list	379
10.11 Doubly linked list	382
10.12 Binary Search Tree (BST)	387
10.13 (a) Binary Search	389
10.13 (b) Towers of Hanoi	390
10.14 Insertion sort using files	391
Appendix – I Additional Problems	393-406
INDEX	407-410