

PROGRAMMING AND DATA STRUCTURES – II

Mrs. Akila T.

(Assistant Professor – CSE Dept.)

**Mahendra College of Engineering,
Salem, Tamil Nadu, INDIA.**

Mr. Jenolin Rex M.

(Assistant Professor – CSE Dept.)

**Mahendra College of Engineering,
Salem, Tamil Nadu, INDIA.**

Mrs. Deepa V.

(Assistant Professor – CSE Dept.)

**Mahendra College of Engineering,
Salem, Tamil Nadu, INDIA.**

PROGRAMMING AND DATA STRUCTURES – II

Copyright © : Mrs. Akila T.
Publishing Rights © : VSRD Academic Publishing
A Division of Visual Soft India Pvt. Ltd.

ISBN-13: 978-93-86258-40-3
FIRST EDITION, MAY 2017, INDIA

Typeset, Printed & Published by:
VSRD Academic Publishing
(A Division of Visual Soft India Pvt. Ltd.)

Disclaimer: The author(s) are solely responsible for the contents of the papers compiled in this book. The publishers or its staff do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the Editors or Publishers to avoid discrepancies in future.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the Publishers & Author.

Printed & Bound in India

VSRD ACADEMIC PUBLISHING
A Division of Visual Soft India Pvt. Ltd.

REGISTERED OFFICE

154, Tezabmill Campus, Anwarganj, KANPUR – 208003 (UP) (IN)
Mb: 99561 27040, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com

MARKETING OFFICE (NORTH INDIA)

Basement-2, Villa-10, Block-V, Charmwood Village, FARIDABAD–121009 (HY)(IN)
Mb: 98999 36803, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com

MARKETING OFFICE (SOUTH INDIA)

340, FF, Adarsh Nagar, Oshiwara, Andheri(W), MUMBAI–400053 (MH)(IN)
Mb: 99561 27040, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com



Thirumigu. M.G.BHARATHKUMAR

Founder & Chairman, Mahendra Educational Trust

Forward

"Computing in their capacity as a tool, computers will be but a ripple on the surface of our culture. In their capacity as intellectual challenge, they are without precedent in the cultural history of mankind".

-Edsger Dijkstra, 1972 Turing Award Lecture

Computer Science as an academic discipline has evolved to embrace a set of intellectual challenges on a par with other sciences. This fact, combined with the undeniable impact of Computer Science on the modern world, demands an introductory college text book comparable with commonly-used textbooks in Physics, Chemistry, or Biology. Accordingly, this book is intended to meet the need for an introductory college text in Computer Science. The distinctive feature of the book is that it has broader coverage of the field than is found in many texts that are currently in use.

I am delighted to note that the Faculties of Computer Science and Engineering and Information technology of Mahendra college of Engineering Mrs. T. Akila along, Mr. M Jenolin Rex and Mrs. V Deepa have written this book on "PROGRAMMING AND DATA STRUCTURES-II" nicely, for the benefit of student community. They have accomplished this goal, and I trust their work will encourage and enlighten all who have an interest in Computers, Computer Science and the growing role on Information and Computer Technology in the modern world.

M.G.BHARATHKUMAR

Founder & Chairman, Mahendra Educational Trust

**Dedicated
To
Our Family, Friends &
Students**

P R E F A C E

The importance of “**PROGRAMMING AND DATA STRUCTURES-II**” is well known in various Engineering fields. This book covers C++ Programming and Non-Linear Data Structures.

Computer programming is becoming a necessary skill for many professions. Writing computer programs is essential to solve complex science and Engineering problems. C++ language is one of the most popular languages today because it is a structured, high level, machine independent language.


Data structure is a particular way of storing and organizing information in a computer so that it can be retrieved and used most productively.

Algorithms and data structures are the basic tools of a programmer. You should understand what they are, why and how they work, and what their shortcomings are. Knowing this will save you a huge amount of time that could be wasted trying to solve a problem that has a solution.

Use of appropriate data structure enables a computer system to perform its task more efficiently, by influencing the ability of computer to store and retrieve data from any location in its memory.

We have divided this book into five chapters, where the first three chapters explain the features of C++ programming & the remaining last two chapters explains the non linear data structures with simple algorithms.

The main aim of this book is to make the students to understand the concepts easily. This book makes the understanding of subject in a clear way and makes it more interesting.

 Mrs. Akila T.

ACKNOWLEDGEMENT

We wish to record our sincere gratitude to the Managing Director **Er. B. Maha Ajay Prasath**, Mahendra College of Engineering, for his constant encouragement and kind support in all our endeavors.

We deem it a proud privilege to extend our greatest sense of gratitude to the Executive Director **Dr. R Samson Ravindran**, Mahendra Engineering Colleges for the inspiring guidance and valuable suggestions throughout the pursuance of this report.

We express our profound thanks to **Dr. R Asokan**, Principal, Mahendra College of Engineering, for his great enthusiasm and inspiration which enabled us to bring this venture to fruition.

We express our sincere thanks to **Dr. N. Malmurugan**, Dean Academics, Mahendra College of Engineering who extended their whole hearted cooperation and moral support for completion of this book.

We would like to express a special note of gratitude to the fantastic editing team of **VSRD Academic Publishing (A Division of Visual Soft India Private Limited)** in releasing this book.

Finally, this work would not have been possible without the love and support of our colleagues, family members and friends. We are extremely grateful to one and all.

✍ Mrs. Akila T.

✍ Mr. Jenolin Rex M.

✍ Mrs. Deepa V.

CONTENTS

CHAPTER 1

OBJECT ORIENTED PROGRAMMING

FUNDAMENTALS.....	1
1.1 INTRODUCTION OF C++	3
1.2 PROCEDURE-ORIENTED PROGRAMMING	4
1.3 OBJECT ORIENTED PARADIGM	6
1.4 BASIC CONCEPTS OF OBJECT ORIENTED PROGRAMMING	7
1.4.1 OBJECTS	8
1.4.2 CLASSES	9
1.4.3 DATA ABSTRACTION AND ENCAPSULATION.....	10
1.4.4 INHERITANCE	10

CHAPTER 2

OBJECT ORIENTED PROGRAMMING CONCEPTS 97

2.1 STRING HANDLING	99
2.2 CONSTRUCTOR AND DESTRUCTOR.....	111
2.3 POLYMORPHISM	128
2.4 FUNCTION OVERLOADING.....	131
2.5 OPERATOR OVERLOADING	133
2.6 DYNAMIC MEMORY ALLOCATION	145
2.7 NESTED CLASSES	148
2.8 INHERITANCE	148
2.9 VIRTUAL FUNCTIONS.....	174

CHAPTER 3

C++ PROGRAMMING ADVANCED FEATURES..... 179

3.1 ABSTRACT CLASSES	181
3.2 EXCEPTION HANDLING	186
3.3 STANDARD LIBRARY	202
3.4 GENERIC PROGRAMMING	204
3.5 STANDARD TEMPLATE LIBRARY (STL).....	215

3.6 FILE HANDLING 224

CHAPTER 4

ADVANCED NON-LINEAR DATA STRUCTURES.....241

4.1 INTRODUCTION TO DATA STRUCTURES 243
4.2 AVL TREE 263
4.3 B – TREE 273
4.4 RED-BLACK TREES..... 283
4.5 SPLAY TREES 296
4.6 BINARY HEAP 299
4.7 FIBONACCI HEAP 310
4.8 THE DISJOINT SET ADT 313
4.9 AMORTIZED ANALYSIS 323

CHAPTER 5

GRAPHS325

5.1 INTRODUCTION TO GRAPHS 327
5.2 REPRESENTATION OF GRAPHS: 330
5.3 GRAPH TRAVERSALS 333
5.4 TOPOLOGICAL SORT 347
5.5 MINIMUM SPANNING TREE (MST) 351
5.6 SHORTEST PATH ALGORITHM 363

QUESTION BANK377