

## Punjab Technical University, Jalandhar

## B.Sc(IT)

Scheme of Syllabi (1<sup>st</sup> Semester )

Course No.	Subject	Marks		Total
		Int	Ext	
BS-101	Communication Skills	40	60	100
BS-103	Basic Mathematics-1	40	60	100
BS-105	Programming in C	40	60	100
BS-107	Fundamentals of Information Technology	40	60	100
BS-109	Software Lab-I(C)	60	40	100
BT-111	Software Lab-II(FIT)	60	40	100
Total		280	320	600

2<sup>nd</sup> Semester

Course No.	Subject	Marks		Total
		Int	Ext	
BS-102	Digital Electronics Fundamentals	40	60	100
BS-104	Mathematics - II (Discrete)	40	60	100
BS-106	RDBMS-I	40	60	100
BS-108	Data Structures through C	40	60	100
BS-110	Software Lab-III (Data Structures)	60	40	100
BT-112	Software Lab-IV (RDBMS)	60	40	100
Total		280	320	600

## **BS-101 COMMUNICATION SKILLS**

Nature of Communication: Process of Communication; Non-verbal Communication; Business Communication; Barriers to Communications; Global Aspects; Ethical; Legal Aspects.

Communication Technology: Electronic Communication Systems; Duplication Technology; Storage Devices.

Principles of Letter Writing: Nature and Functions of Letters; Principles.

Structure and layout: Elements of Structure; Forms of Layout; Styles of Presentation

Planning and Preparation: Importance of Planning; Five Steps of to Planning.

Quotations, Order and Tenders: Inviting Quotations; Sending Quotations; Placing Order; Inviting Tenders.

Sales Letters: Qualities of a Sales Letters; Writing a Sales letter.

Claim and Adjustment Letters: making Claims; Offering Adjustments.

Credit and collection Letters: Nature of a Credit Letters; Types of a Credit letter; Collection Procedure;; Summary of Distinctive Features of Business Letters.

Handling Correspondence: Receipt and Dispatch of Mail; Noting on the Files; Filing Systems; Classification mail.

Social Correspondence: Role and Function; Types.

Business and technical reports: Characteristics; Importance; types; Routine reports

Structure and Layout: Elements of Structure; Front Matter; main Body; Back Matter

Planning and Preparation: import preparatory Steps; Source of Data; Evolution of Material, note making, organizing Material; principles of Organization; Making Outline Elements of Style: The Scientific Attitude; Readability.

Use of Illustrations: purpose; Types.

Technical Description : techniques of Description; Describing machines and Mechanisms; Describing Process; Sample Descriptions.

Writing the report : Rough Draft ; Process of Writing ; Order of Writing; the Final Draft; Check-list for Reports.

Specimen Reports : report from Industry; Socio-Cultural Survey report; technical report; Interpretive report; Letter Report.

Oral Presentation : Importance of Acquiring Oral Presentation Skills; Body Language; Voice Modulation; Audience Awareness; Presentation Plan; Visual Aids; use of Connectives; Check lists; Evaluation; brochure; Conducting a Meeting; Participating in a Meeting.

Application Letter: Importance and Function; Drafting the Application; Elements of Structure; preparing the resume; Helpful Hints; Job Offer; Resignation Letter.

Employment Interview: Types of Interview; Preparing for the Interviews; Attending the Interview; Interview Process; Employers Expectation; Conducting an Interview; Negative Aspects.

Group Discussion: Definition; Process; Guidelines; Helpful expressions; Evaluation

## **BS-103 BASIC MATHEMATICS-I**

**RELATION AND FUNCTIONS:** Elements of set methods of describing a set; types of set; operations on sets, union intersection and difference of set Duality, Partitioning of a set; trigonometric functions.

### **BINOMIAL THEOREM AND ITS APPLICATION**

**MATRIX:** Introduction to matrix; properties of matrix; evaluation of determinant; minor and co-factors and properties of determinant.

**STATISTICS:** Introduction to statistics, collation, and tabulation of data, mean median and mode.

**SERIES:** AP Series, GP Series.

## **BS-105 PROGRAMMING IN C**

Origin & Introduction to C: About o C, Evolution of C, Programming Languages, Structure of a C program, Compiling a C program, Compiler & interpreters, Pseudopodia, Simple C program, Character set in C, Keywords in C, Hierarchy of operators, Basic Data Types, Qualifiers used with basic data types, Variable in C, Type declaration, output function, Input function and format specify, Arithmetic operators, Unary operators, Relational and logical operators, Constraints in C,

Decision Making, Branching & Looping: Why control statements, the if statement, if else statement, for statement, whiled loop, do while statement, break statements,, continue statements, switch statement, go to statement, ternary operators,

Arrays & String Handling's: introduction to arrays, advantages of arrays, types of arrays, array declaration, array initialization, accessing data from array, array inside the memory, multidimensional arrays, Character arrays overflow, string Variables, Reading& writing strings, string handling functions.

User Defined Function: Introduction functions, advantages of function, declaring a function, calling a function, variables, passing arguments for a function, nested function, passing array to functions, recursion in function, Call by Valve and Call reference.

Pointers: Introduction to pointers, pointer variation, dynamic memory allocation, pointers and arrays, pointers to pointers functions returning pointers, 2 Dimensional arrays and pointers, array of pointers .

File Management in C: Defining & opening a file , I/O operations on file, error handling during I/I operations, Random Access Files.

### **Recommended Books:**

**Programming in C by Balagurswami-TMH Publication**

**BSIT-107 FUNDAMENTALS OF INFORMATION TECH.**

Introduction: Characteristics of Computers, The Evolution of Computers, The Computers Generations (First Generation (1942-1955), Second Generation (1955-1964), Third generation (1964-75), Fourth Generation (1975-1989), Fifth Generation (1989-present).

Basic Computer Organization: Input Unit, Output unit, Storage Unit, Arithmetic Logic Unit, Control Unit, Central processing Unit, The System Concept.

Number of Systems: Non-positional number Systems, Positional Number Systems (Binary Number Systems, Octal Number System, Hexadecimal Number System, Converting One System to another (Converting to Decimal from Another base, Converting from Decimal to another Base (Division-Remainder Technique), Converting from a base other than 10 to base other than 10, Shortcut method for Binary to Octal Conversion, Shortcut method for Octal to Binary. Conversion, Shortcut method for Binary to Hexadecimal Conversion, Shortcut Method for Hexadecimal to binary Conversion, Fractional Numbers.

Processor and Memory: The central Processing Unit (CPU) (The Arithmetic Logical Unit (ALU), Instruction Set, and registers, Processor Speed, types of Processor) The main memory (storage evaluation Criteria, main memory Organization, Main memory Capacity, RAM, ROM, PROM and EPROM Cache Memory.

Secondary storage Devices: Sequential and direct-Access devices, Magnetic Tape (basic Principles of Operation, Types of magnetic tapes, Advantages and Limitation of magnetic tapes, Uses of Magnetic Disks), Optical Disk (Basic Principles of Operation, Types of Optical Disks, Advantages and Limitations of Optical Disks, Uses of Optical disks, Mass storage Devices (Disk Array, Automated Tape Library, CD-ROM Jukebox), Storage Devices Hierarchy.

Input-Output Devices: Input Devices (Keyboard Devices, Point and draw Devices, Digitizer, Electronic Card reader, Voice Recognition Devices, Vision Input (system) output Devices (Monitors, Printers, projectors, Screen Image, project, Voice response Systems).

Computer Languages: Analogy with natural Languages, Language (Advantages and Limitations of Machine language, Assembly Language (Assembler, Advantage of Assembly Language over machine language, Limitation of Assembly Language, Assembly Languages with Micro Industries). High Level Language (compiler, Linker, Interpreter, Advantages and Limitations of High-Level Languages) Object-Oriented Programming Languages, Some High-level Languages (Fortran, Cobol, basic, Pascal) Some More High-Level Languages (C++ and C, Java, RPG LISP, SNOBOL) Characteristics of a Good Programming Language, Selecting a Language for Coding and Application, Subprogram.

Application Software Package: Word-Processing Package (What It Is?, Commonly Supported Features), Spreadsheets Package (What it Is?) Commonly Supported Features, graphics Package (what it is? Commonly Supported features); Personal Assistance Package (What it is?) Commonly Supported Features).

The Internet: definition (What it is?) brief History, Basic Services (Electronic Mail, Protocol, telnet Usenet, news, The world wide Web) WWW Browser, Uses of the Internet.

Classification of Computers: Notebook Computers, Personal Computers (PCs) work stations, Mainframe Systems, Supercomputers, Clients and Services.

### MS-OFFICE 2000

Microsoft Office 2000:- introduction,, Microsoft Word 2000, Microsoft Excel 2000, Microsoft Access 2000, Microsoft PowerPoint 2000, Microsoft Outlook 2000, Internet Explorer 5.0, Microsoft FrontPage 2000, Microsoft Publisher 2000, Microsoft Photo draw 2000, Microsoft Office bar, Using the Mouse (To Click, To double –Click, To select, To drag, To Scroll, To choose form a menu, To mover a window, to resize a window, To minimize a window, to restore a minimized Window, To maximize a window, To switch windows, To close a window, remember ) Microsoft Office 2000 and Web ((Microsoft Word 2000, Micro Excel 2000, Microsoft access 2000, Microsoft power point 2000 , Microsoft Outlook 2000, Microsoft FrontPage 2000) common Keyboard Commands.

Creating Your Document in Words: Introduction, Saving the file, formatting the text Alignment of text, Applying Fonts, Spell checking, Consulting thesaurus, Assign Character Styles (Assign a Character Style (Assign a Character Style, Create a character style) borders and shading (apply Borders and Shading) Closing of the file, Save as (From file menus, from open, Icon) printing your document.

Proofing Your Document in Word 2000: Introduction, Editing Tools, Auto correct (Add Auto correct Entries Without formatting, Add new auto correct entries with formatting, Auto Text (Creating an auto text entry, Auto complete option) auto format (auto format as you type auto format on command, autofomating text) Find and replace, find replace text Page Numbering, header and footer (Adding a header or footer in our document) Footnotes and endnotes (Add a footnote or endnote

Creating a Worksheet in Excel 2000: Introduction, Copying, and Formula.

Advanced techniques of Excel 2000: Auditing a workbook (to trace the precedents for a formula), Comment inserting (To insert a comment) Formulas that decisions (How the If function works) Header and footers, Merging workbooks (to merge workbooks) Outlines a worksheet automatically, clear entire Outline, Show or hide outline symbols, group

rows of columns in an outline ungroup rows, remove group from Outline, Set outline options), printing column and Row Labels on Every page protecting a Workbook ( To unlock cells so that others can edit the cell contents, to protect a workbook to share a workbook) ranges, Naming (To name a range) references (Absolute references, Mixed references) Seeking Goals (To seek a goal) sheets Naming (To name a sheet) Working with Workbooks (Copying Entries between Workbooks, Moving Sheets between workbooks deleting sheets).

Creating presentation Using auto content wizard , creating new presentation, Introduction, Changing views.

**Recommended Books:**

**Computer Fundamentals- Pradeep K.Sinha, Preeti Shina-BPB Publications**

**BS-102 DIGITAL ELECTRONICS FUNDAMENTALS****INSTRUCTIONS FOR PAPER-SETTER**

The question paper will consist of Two parts, A and B. Part A will have 15 short answer questions (40-60 words) of 2 marks each. Part B will have 12 long answer questions of 5 marks each.

The syllabus of the subject is divided into 3 sections I, II and III. The question paper will cover the entire syllabus uniformly. Part A will carry 5 questions from each section and Part B will carry 4 questions from each section.

**INSTRUCTION FOR CANDIDATES**

Candidates are required to attempt all questions from Part A and 9 questions of Part B out of 12.

**Section I**

**FUNDAMENTAL CONCEPTS:** Introduction, Digital Signals, Basic digital circuits (AND Operation, NOT Operation, OR Operation), NAND and NOR Operations, Exclusive - OR Operation, Boolean Algebra, Examples Of IC Gates.

**NUMBER SYSTEMS AND CODES:** Introduction, Number Systems, Binary Number System(Binary to Decimal Conversion, Decimal to Binary Conversion), Signed Binary Numbers(Sign Magnitude Representation, 1's Complement Representation, 2's Complement Representation), Binary Arithmetic (Binary Addition, Binary Subtraction, Binary Multiplication, Binary Division), 2's Complement Arithmetic (Subtraction using 2's Complement, Addition/Subtraction using 2's Complement), Octal Number System(Octal to Decimal Conversion, Octal to Binary Conversion, Decimal to Octal Conversion, Binary to Octal Conversion, Octal Arithmetic, Applications of Octal Number System), Hexadecimal Number System(Hexadecimal to Decimal Conversion, Decimal to Hexadecimal Conversion, Hexadecimal to Binary Conversion, Binary to Hexadecimal Conversion, Conversion from HEX to Octal and vice versa, Hexadecimal Arithmetic), Codes (Straight Binary Code, Natural BCD Code, Excess-3 Code, Gray Code, Octal Code, Hexadecimal Code, Alphanumeric Code), Error Detecting and Error Correcting Codes.

**COMBINATIONAL LOGIC CIRCUITS:** Introduction, Standard Representation for Logical

Functions, Karnaugh Map Representations of Logical Functions (Representation of Truth Table on K-Map, Representation of Standard SOP Form on K-Map, Representation of Standard POS Form on K-Map), Simplification of Logical Functions Using K Map (Grouping two adjacent Ones, Grouping four adjacent Ones, Grouping 2, 4 and 8 adjacent Ones), Minimization of Logical Functions Specified in Minterms/Maxterms or Truth Table (Minimization of SOP Form, Minimization of POS Form), Minimization of Logical Functions not specified in Minterms/Maxterms, Don't Care Conditions, Design Examples (Arithmetic Circuits, BCD to 7 Segment Decoder), EX-OR AND EX-NOR Simplification of K-Maps (Diagonal and Offset Adjacencies of Groups of Ones), Five and Six Variable K-Maps, Quine-Mc Cluskey Minimization Technique.

## **Section II**

**COMBINATIONAL LOGIC DESIGN USING MSI CIRCUITS:** Introduction, Multiplexers and Their use in Combinational Logic Design ( Multiplexer, Combinational Logic Design Using Multiplexers, Multiplexer Tree), Demultiplexers/Decoders and their use in Combination Logic Design (Demultiplexer, Demultiplexer Tree), Address and their use as Subtractors (Adder with Look Ahead Carry, Cascading of Adders, Subtraction Using Adder), BCD Arithmetic (BCD Adder, BCD Subtractor), Arithmetic and Logic Unit (ALU).

**FLIP FLOP's :** Introduction, A 1-Bit Memory Cell, Clocked S-R Flip-Flop (Preset and Clear), J-K Flip-Flop (Race around Condition, Master Slave JK Flip Flop), D-Type Flip Flop, T-Type Flip Flop, Excitation Table of Flip Flop, Clocked Flip Flop Design (Conversion from one type of Flip Flop to Another Type), Edge Triggered Flip Flop's, Application of Flip Flop's (Bounce-Elimination Switch, Registers, Counters, Random Access Memory).

## **Section III**

**SEMICONDUCTOR MEMORIES :** Introduction, Memory Organization and Operation (Write

Operation, Read Operation), Expanding Memory Size (Expanding Word Size, Expanding Word Capacity), Classification and Characteristics of Memories (Principle of Operations, Physical Characteristics, Mode Of Access, Fabrication Technology), Sequential Memory(Static Shift Register, Dynamic Shift Register), Read Only Memory (ROM Organization, Programming Mechanisms, ROM IC's), Read and Write Memory(Bipolar RAM Cell, MOS RAMs, RAM ICs), Content Addressable Memory(Operation of CAM), Charge Coupled Device Memory(Basic Concept of CCD, Operation of CCD, A Practical CCD Memory Device).

**Reference Books :-**

1. Tokheim, Digital Electronics: Principles & Applications
2. Taub, Herbert, Digital Integrated Electronics
3. Mithal, G.K., Pulse & Digital Electronics
4. Jain, R.P., Modern Digital Electronics
5. Malvino, Digital Electronics Principles
6. Malvino, Digital Principles & Applications

**BS-104 MATHEMATICS - II (DISCRETE)****INSTRUCTIONS FOR PAPER-SETTER**

The question paper will consist of Two parts, A and B. Part A will have 15 short answer questions (40-60 words) of 2 marks each. Part B will have 12 long answer questions of 5 marks each.

The syllabus of the subject is divided into 3 sections I, II and III. The question paper will cover the entire syllabus uniformly. Part A will carry 5 questions from each section and Part B will carry 4 questions from each section.

**INSTRUCTION FOR CANDIDATES**

Candidates are required to attempt all questions from Part A and 9 questions of Part B out of 12.

**Section I**

**SET THEORY** :Set & Its elements, Set description, Types of Sets, Ven-Euler Diagrams, Basic Set Operations, Fundamental products, Partitions of Sets, Minsets, Algebra of Sets & Duality.

**RELATIONS & DIAGRAPHS** : Cartesian Product of sets, Binary relations, Representation of relations on finite sets, Path in relations & diagraphs, Types of relations, Composition of relations.

**FUNCTIONS** : Definition & notation of a function, Types of functions, Invertible functions, Composition of functions, Functions for computer science, Set representation in a Computer, Greatest common divisor, Least Common Multiple.

**Section II**

**MATHEMATICAL INDUCTION** : Principle of Mathematical Induction.

**PERMUTATIONS & COMBINATIONS** : Role of Sum & Product, Permutations (Important deductions, Permutations with Repetition of Objects, Circular Permutations, Restricted Permutations), Combinations (Important Results, restricted combinations, combinations of objects not all different).

**Section III**

**RECURRENCE** : Recurrence relation, Linear recurrence relation with constant coefficients,  
Solution of Linear recurrence relation with constant coefficients, Solution of non-homogeneous recurrence relations, Methods of generating functions.

**MATHEMATICAL LOGIC** : Propositional Calculus, Basic Logical operations (Conjunction, disjunction, Negation, derived connectives), Statements generated by a set, conditional statements, Converse Inverse & Contrapositive statements, Biconditional statements, Tautologies, Contradiction, Contingency, Argument, Methods of proof, Equivalence & Implication, Statement Calculus.

**BOOLEAN ALGEBRA** : Laws of Boolean algebra, Basic Theorems, Duality Principle, Boolean Functions, Applications of Boolean Algebra.

**Reference Books:-**

1. Lipschutz, Seymour, Discrete Mathematics (Schaum Series)
2. Kolman, Bernard, Discrete Mathematical Structures
3. S.B. Singh, Discrete Structures
4. Bhupinder Singh, Discrete Mathematics & Its Applications
5. Rm. Somasundram, Discrete Mathematical Structures.

## **BS-106 RDBMS-I**

### **INSTRUCTIONS FOR PAPER-SETTER**

The question paper will consist of Two parts, A and B. Part A will have 15 short answer questions (40-60 words) of 2 marks each. Part B will have 12 long answer questions of 5 marks each.

The syllabus of the subject is divided into 3 sections I, II and III. The question paper will cover the entire syllabus uniformly. Part A will carry 5 questions from each section and Part B will carry 4 questions from each section.

### **INSTRUCTION FOR CANDIDATES**

Candidates are required to attempt all questions from Part A and 9 questions of Part B out of 12.

### **Section I**

**Introduction to Office 2000:** Introduction Microsoft Office 2000, Benefits of Office 2000, What is New in Office 2000, Overview of Office 2000, Launching Office 2000 Applications, Switching between Office 2000 Applications, Office 2000 Help System, Detect & Repair Windows, Menus and Toolbars, Closing (Existing) Office Applications, Windows, Menus, Dialog Boxes and Toolbars, Application Windows, The Application's Workplace, Document Navigation, Working with Several Document Windows, Menus and Dialog Boxes, Dialog Box Options, Toolbars, Printing Documents, Exercises.

**Introduction to Databases, DBMS and RDBMS :** Introduction, Information, Quality of Information, Information Processing, What is a Database?, Why a Database?, Characteristics of Data in a Database, What is a Database Management System (DBMS)?, Need for DBMS, Types of DBMS, Relational Database Management Systems (RDBMS), RDBMS Terminology, Relational Data Structure, Relational Data Intergrity, Conclusion, Review Questions.

### **Section II**

**Access 2000 Basics :** Introduction, Starting Access 2000, Access Startup Dialog Box, Menus and Toolbars, Using Toolbar Buttons, Arranging Buttons on the Toolbar, Viewing Data, Creating an Access 2000 Database and Tables, Database Properties, Modifying Tables, Creating Forms,

Entering and Updating Data Using Forms, Navigating between Records in a Form, Finding,  
Editing and Deleting Data in a Form, Using Access 2000 Help, Using Answer Wizard, Using the  
Contents Tab to Get Help, Using the Index Tab to get Help, Exercises.  
**Report and Queries** : Introduction, Sorting and Filtering Records, Creating and Printing Reports,  
Creating and Using Queries.

### **Section III**

**Introduction to Structured Query Language (SQL)** : Introduction, Characteristics of SQL,  
Advanges of SQL, Types of SQL Tables, Create Table, NULLS, Data Manipulation, Update  
Operations, SQL in Access.

**Query by Example (QBE)** : Introduction, SELECT Queries in QBE, Make-Table Query,  
DELETE Query, UPDATE Query, APPEND Query, Conclusion, Exercises.

#### **Reference Books:-**

1. Ullman, Principles of Database Systems
2. Kroenke, D, Database Processing
3. Naveen Parkash, Introduction to Database Management

**BS-108 DATA STRUCTURES THROUGH C****INSTRUCTIONS FOR PAPER-SETTER**

The question paper will consist of Two parts, A and B. Part A will have 15 short answer questions (40-60 words) of 2 marks each. Part B will have 12 long answer questions of 5 marks each.

The syllabus of the subject is divided into 3 sections I, II and III. The question paper will cover the entire syllabus uniformly. Part A will carry 5 questions from each section and Part B will carry 4 questions from each section.

**INSTRUCTION FOR CANDIDATES**

Candidates are required to attempt all questions from Part A and 9 questions of Part B out of 12.

**Section I**

**Analysis of Algorithms :** Why Analyze Algorithms?; What is Analysis?; What Analysis doesn't do?; What to count and consider?; Cases to Consider during Analysis; Rates of Growth; Analysis of Sequential Search Algorithm (Worst Case Analysis, Average Case Analysis).

**Arrays :** What are Arrays?; Array Operations; Merging of Two Arrays; Two-Dimensional Arrays (Row Major and Column Major Arrangement, Common Matrix Operations, More Matrix Operations); Array of Pointers; Multidimensional Arrays; Arrays and Polynomials; Multiplication of Polynomials.

**Strings :** What are Strings?; Representation of Strings; Operations on Strings; Pointers and Strings; A Two-Dimensional Array of Strings; Array of Pointers to Strings; Limitation of Array of Pointers to Strings; Pattern Matching (Brute Force Algorithm); Few More String Functions.

**Section II**

**Linked Lists :** What is a Linked List?; Operations on Linked Lists; Ascending Order Linked Lists; Reversing the Links; Merging of Linked Lists; Sorting a Linked List; Circular Linked List (Function `delcirq()`, Function `cirq_display()`); A few more Operations; Recursive Operation on Linked Lists;

Doubly Linked Lists (Function d\_append(), Function d\_addatbeg(), function d\_addafter(), function d\_delete()); Linked Lists and Polynomials (Function poly\_multiply(), Function padd()).

**Sparse Matrices :** Representation of Sparse Matrix as an Array; Common Matrix Operations;  
Transpose of a Sparse Matrix; Addition of Two Sparse Matrices; Multiplication of Two Sparse Matrices; Linked Representation of a Sparse Matrix; Other forms of a Sparse Matrix.

**Stacks :** Operations on Stack; Stack as an Array; Stack as a Linked List; Applications of Stacks;  
Infix to Prefix Conversion; Infix to Post-fix conversion; Postfix to prefix conversion; postfix to infix conversion; Evaluation of Postfix expression.

**Queues :** Representation of Queue as an Array; Representation of a Queue as a Linked List;  
Circular Queues; Dequeue; Priority Queue; Array Implementation of a Priority Queue.

### **Section III**

**Trees :** Binary Trees; Traversal of a Binary Tree; Representation of a Binary Trees in Memory  
(Linked Representation of Binary Trees, Array Representation of Binary Trees, Binary Search Trees); Operations on a Binary Search Tree (Searching of a Node in a BST, Insertion of a Node in a BST, Deletion from a Binary Tree, Applications of Binary Trees (Representing Expressions In Binary Trees)).

**Searching and Sorting :** Searching (Linear Search, Binary Search, Comparison of Linear Search and Binary Search); Sorting (Internal Sorting, External Sorting); Internal Sorting (Bubble Sort, Selection Sort, Quick Sort, Insertion Sort); External Sorting.

### **Reference Books:-**

1. Radhakrishnan, M, Data Structuring Using C.
2. Weiss, Mark Allen, Data Structures & Algorithm Analysis in C.