# **Core Programming**

## **Core Programming: Reference-1**

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# **Discrete Mathematics**

## **Discrete Mathematics: Reference-1**

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| 185 | The Pigeonhole Principle – Topics 3 |
| 188 | Permutations and Combinations – Topics 3 |
| 191 | Binominal Coefficients and Identities – Topics 3 |
| 196 | Generalized Permutations and Combinations – Topics 5 |
| 199 | Generating Permutations and Combinations – Topics 3 |
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| 216 | Bayes’ Theorem – Topics 3 |
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|  | **Advanced Counting Techniques** |
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| 230 | Solving Linear Recurrence Relations – Topics 3 |
| 232 | Divide-and-Conquer Algorithms and Recurrence Relations – Topics 2 |
| 237 | Generating Functions – Topics 5 |
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| 255 | n-ary Relations and Their Applications – Topics 6 |
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| 267 | Equivalence Relations – Topics 4 |
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| 281 | Graph Terminology and Special Types of Graphs – Topics 7 |
| 287 | Representing Graphs and Graph Isomorphism – Topics 6 |
| 294 | Connectivity – Topics 7 |
| 298 | Euler and Hamilton Paths – Topics 4 |
| 301 | Shortest-Path Problems – Topics 3 |
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| 313 | Applications of Trees – Topics 5 |
| 317 | Tree Traversal – Topics 4 |
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|  | **Boolean Algebra** |
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| 346 | Finite-State Machines with Output – Topics 2 |
| 351 | Finite-State Machines with No Output – Topics 5 |
| 356 | Language Recognition – Topics 5 |
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# **Data Structure**

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| 03 | Algorithm Specification – Topics 2 |
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| 08 | Performance Analysis – Topics 4 |
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| 14 | Structures and Unions – Topics 4 |
| 17 | The Polynomial Abstract Data Type – Topics 3 |
| 18 | The Representation of Multidimensional Arrays |
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| 22 | The Representation of Multidimensional Arrays |
| 24 | The String Abstract Data Type – Topics 2 |
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| 25 | The Sack Abstract Data Type |
| 26 | The Queue Abstract Data Type |
| 27 | A Mazing Problem |
| 30 | Evaluation of Expressions – Topics 3 |
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| 35 | Dynamically Linked Stacks and Queues |
| 40 | Polynomials – Topics 5 |
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|  | **Trees** |
| 45 | Introduction – Topics 2 |
| 48 | Binary Trees – Topics 3 |
| 49 | Binary Tree Traversals |
| 50 | Additional Binary Tree Operations |
| 51 | Threaded Binary Trees |
| 55 | Heaps – Topics 4 |
| 60 | Binary Search Trees – Topics 5 |
| 61 | Selection Trees |
| 63 | Forests – Topics 2 |
| 65 | Set Representation – Topics 2 |
| 69 | Counting Binary Trees – Topics 4 |
|  | References and Selected Readings |
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|  | **Graphs** |
| 72 | The Graph Abstract Data Type – Topics 3 |
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| 78 | Minimum Cost Spanning Trees |
| 81 | Shortest Paths and Transitive Closure – Topics 3 |
| 83 | Activity Networks – Topics 2 |
|  | References and Selected Readings |
|  | Additional Exercises |
|  | **Sorting** |
| 87 | Searching and List Verification – Topics 4 |
| 88 | Definitions |
| 89 | Insertion Sort |
| 90 | Quick Sort |
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| 94 | Merge Sort – Topics 3 |
| 95 | Heap Sort |
| 96 | Radix Sort |
| 97 | List and Table Sorts |
| 98 | Summary of Internal Sorting |
| 103 | External Sorting – Topics 5 |
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|  | **Hashing** |
| 104 | The Symbol Table Abstract Data Type |
| 108 | Static Hashing – Topics 4 |
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|  | **Heap Structures** |
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| 117 | Deaps – Topics 3 |
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|  | **Search Structures** |
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| 132 | AVL Trees |
| 136 | 2-3 Trees – Topics 4 |
| 139 | 2-3-4 Trees – Topics 3 |
| 144 | Red-Black Trees – Topics 5 |
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| 05 | The Game of Life – Topics 4 |
| 08 | Programming Style – Topics 3 |
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| 28 | Stack Specifications – Topics 5 |
| 32 | Implementation of Stacks – Topics 4 |
| 33 | Application: A Desk Calculator |
| 34 | Application: Bracket Matching |
| 37 | Abstract Data Types and Their Implementations – Topics 3 |
|  | Pointers and Pitfalls |
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|  | References for Further Study |
|  | **Queues** |
| 39 | Definitions – Topics 2 |
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| 41 | Circular Implementation of Queues in C++ |
| 42 | Demonstration and Testing |
| 49 | Application of Queues: Simulation – Topics 7 |
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| 53 | Linked Stacks |
| 57 | Linked Stacks with Safeguards – Topics 4 |
| 59 | Linked Queues – Topics 2 |
| 65 | Applications: Polynomial Arithmetic – Topics 6 |
| 66 | Abstract Data Types and Their Implementations |
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|  | **Recursion** |
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| 75 | Principles of Recursion – Topics 5 |
| 82 | Backtracking: Postponing the Work – Topics 7 |
| 87 | Tree-Structured Programs: Look-Ahead in Games – Topics 5 |
|  | Pointers and Pitfalls |
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|  | **Lists and Strings** |
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| 94 | Implementation of Lists – Topics 6 |
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| 99 | Application: A Text Editor – Topics 2 |
| 100 | Linked Lists in Arrays |
| 101 | Application: Generating Permutations |
|  | Pointers and Pitfalls |
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|  | **Searching** |
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| 103 | Sequential Search |
| 107 | Binary Search – Topics 4 |
| 111 | Comparison Trees – Topics 4 |
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|  | **Sorting** |
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| 121 | Insertion Sort – Topics 4 |
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| 126 | Shell Sort |
| 127 | Lower Bounds |
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| 131 | Merge-sort for Linked Lists – Topics 2 |
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| 141 | Review: Comparison of Methods |
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| 154 | Hashing – Topics 4 |
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| 211 | Graph Traversal – Topics 3 |
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| 218 | A Greedy Algorithm: Shortest Paths – Topics 4 |
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# **Algorithm**

## **Algorithm: Reference-1**

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| 18 | Dictionaries – Topics 2 |
| 20 | Priority Queues – Topics 2 |
| 22 | Sets and Disjoint Set Union – Topics 2 |
| 25 | Graphs – Topics 3 |
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|  | **Divide-and-Conquer** |
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| 28 | Finding the Maximum and Minimum |
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| 34 | Strassen’s Matrix Multiplication |
| 38 | Convex Hull – Topics 4 |
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|  | **The Greedy Method** |
| 39 | The General Method |
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| 48 | Minimum-Cost Spanning Trees – Topics 3 |
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|  | **Dynamic Programming** |
| 52 | The General Method |
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| 54 | All Pairs Shortest Paths General Weights |
| 55 | Optimal Binary Search Trees |
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| 60 | Flow Shop Scheduling |
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| 63 | Techniques for Graphs – Topics 2 |
| 64 | Connected Components and Spanning Trees |
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|  | **Backtracking** |
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| 67 | The 8-Queens Problem |
| 68 | Sum of Subsets |
| 69 | Graph Coloring |
| 70 | Hamiltonian Cycles |
| 71 | Knapsack Problem |
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|  | **Lower Bound Theory** |
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| 94 | Oracles and Adversary Arguments – Topics 4 |
| 100 | Lower Bonds Through Reductions – Topics 6 |
| 101 | Techniques for Algebraic Problems |
|  | References and Readings |
|  | **NP-Hard and NP-Complete Problems** |
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| 104 | Cook’s Theorem |
| 110 | NP-Hard Graph Problems – Topics 6 |
| 113 | NP-Hard Scheduling Problems – Topics 3 |
| 115 | NP-Hard Code Generation Problems – Topics 2 |
| 116 | Some Simplified NP-Hard Problems |
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| 129 | Probabilistically Good Algorithms |
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| 02 | Random Access Machines |
| 03 | Computational Complexity of RAM Programs |
| 04 | A Stored Program Model |
| 05 | Abstractions of the RAM |
| 06 | A Primitive Model of Computation: The Turing Machine |
| 07 | Relationship Between the Turning Machine and RAM Models |
| 08 | Pidgin ALGOL – A High-Level Language |
|  | **Design of Efficient Algorithms** |
| 09 | Data Structures: Lists, Queues, and Stacks |
| 10 | Set Representations |
| 11 | Graphs |
| 12 | Trees |
| 13 | Recursion |
| 14 | Divide-and-Conquer |
| 15 | Balancing |
| 16 | Dynamic Programming |
| 17 | Epilogue |
|  | **Sorting and Order Statistics** |
| 18 | The Sorting Problem |
| 19 | Radix Sorting |
| 20 | Sorting by Comparisons |
| 21 | Heapsort – an O(n log n) Comparison Sort |
| 22 | Quicksort – an O(n log n) Expected Time Sort |
| 23 | Order Statistics |
| 24 | Expected Time for Order Statistics |
|  | **Data Structures for Set Manipulation Problems** |
| 25 | Fundamental Operations on Sets |
| 26 | Hashing |
| 27 | Binary Search |
| 28 | Binary Search Trees |
| 29 | Optimal Binary Search Trees |
| 30 | A Simple Disjoint-Set Union Algorithm |
| 31 | Tree Structures for the UNION-FIND Problem |
| 32 | Applications and Extensions of the UNION-FIND Algorithm |
| 33 | Balanced Tree Schemes |
| 34 | Dictionaries and Priority Queues |
| 35 | Mergeable Heaps |
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| 37 | Partitioning |
|  | **Algorithms on Graphs** |
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| 39 | Depth-First Search |
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| 41 | Depth-First Search of a Directed Graph |
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| 46 | Path Problems and Matrix Multiplication |
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| 48 | Dominators in a Directed Acyclic Graph: Putting the Concepts Together |
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| 50 | Strassen’s Matrix-Multiplication Algorithm |
| 51 | Inversion of Matrices |
| 52 | LUP Decomposition of Matrices |
| 53 | Applications of LUP Decomposition |
| 54 | Boolean Matrix Multiplication |
|  | **The Fast Fourier Transform and Its Applications** |
| 55 | The Discrete Fourier Transform and Its Inverse |
| 56 | The Fast Fourier Transform Algorithm |
| 57 | The FFT Using Bit Operations |
| 58 | Products of Polynomials |
| 59 | The Schonhage-Strassen Integer-multiplication Algorithm |
|  | **Integer and Polynomial Arithmetic** |
| 60 | The Similarity Between Integers and Polynomials |
| 61 | Integer Multiplication and Division |
| 62 | Polynomial Multiplication and Division |
| 63 | Modular Arithmetic |
| 64 | Modular Polynomial Arithmetic and Polynomial Evaluation |
| 65 | Chinese Remaindering |
| 66 | Chinese Remaindering and Interpolation of Polynomials |
| 67 | Greatest Common Divisors and Euclid’s Algorithm |
| 68 | An Asymptotically Fast Algorithm for Polynomial GCD’s |
| 69 | Integer GCD’s |
| 70 | Chinese Remaindering Revisited |
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|  | **Pattern-Matching Algorithms** |
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| 73 | Recognition of Regular Expression Patterns |
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|  | **NP-Complete Problems** |
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| 78 | The Classes P and NP |
| 79 | Languages and Problems |
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| 81 | Additional NP-Complete Problems |
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|  | **Some Provably Intractable Problems** |
| 83 | Complexity Hierarchies |
| 84 | The Space Hierarchy for Deterministic Turing Machines |
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| 86 | A Non-elementary Problem |
|  | **Lower Bounds on Numbers of Arithmetic Operations** |
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| 89 | A Matrix Formulation of Problems |
| 90 | A Row-Oriented Lower Bound on Multiplications |
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| 92 | A Row-and-Column-Oriented Bound on Multiplications |
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| 05 | Getting Started – Topics 3 |
| 07 | Growth of Functions – Topics 2 |
| 13 | Divide-and-Conquer – Topics 6 |
| 17 | Probabilistic Analysis and Randomized Algorithms – Topics 4 |
|  | **Part-2: Sorting and Order Statistic** |
| 22 | Heapsort – Topics 5 |
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| 30 | Sorting in Linear Time – Topics 4 |
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| 50 | Red-Black Trees – Topics 4 |
| 53 | Augmenting Data Structures – Topics 3 |
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|  | **Part-5: Advanced Data Structure** |
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| 74 | Fibonacci Heaps – Topics 4 |
| 77 | Van Emde Boas Trees – Topics 3 |
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# **Database Management System**

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# **Software Engineering**

## **Software Engineering: Reference-1**

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|  | **Concluding Comments** |
| 503 | The Importance of Software – Revisited |
| 504 | People and The Way They Build Systems |
| 505 | New Modes for Representing Information |
| 506 | The Long View |
| 507 | The Software Engineer’s Responsibility |
| 508 | A Final Comment |
|  | **Part-6: Appendix** |
| 509 | An Introduction to UML |
| 510 | Object Oriented Concepts |

# **Pure Mathematics – 1, 2, and 3**

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|  | **Pure Mathematics (A-Level)** |
|  | **P1: Algebra** |
| 01 | Background Algebra |
| 02 | Linear Equations |
| 03 | Changing the Subject of a Formula |
| 04 | Quadratic Equations |
| 05 | Solving Quadratic Equations |
| 06 | Equations that cannot be Factorized |
| 07 | The Graphs of Quadratic Function |
| 08 | The Quadratic Formula |
| 09 | Inequalities |
|  | **P2: Algebra** |
| 10 | Operations with Polynomials |
| 11 | Solution of Polynomial Equations |
| 12 | The Modulus Function |
|  | **P3: Further Algebra** |
| 13 | The General Binomial Expansion |
| 14 | Review of Algebraic Functions |
| 15 | Partial Functions |
| 16 | Using Partial Functions with The Binomial Expansion |
|  | **P1: Co-Ordinate Geometry** |
| 17 | Co-Ordinates |
| 18 | Plotting, Sketching and Drawing |
| 19 | The Gradient of a Line |
| 20 | The Distance Between Two Points |
| 21 | The Mid-Point of a Line Joining Two Points |
| 22 | The Equation of a Straight Line |
| 23 | Finding the Equation of a Line |
| 24 | The Intersection of Two Line |
| 25 | Drawing Curves |
| 26 | The Intersection of A Line and A Curve |
|  | **P1: Sequences and Series** |
| 27 | Definitions and Notation |
| 28 | Arithmetic Progressions |
| 29 | Geometric Progressions |
| 30 | Binomial Expansions |
|  | **P1: Functions** |
| 31 | The Language of Functions |
| 32 | Composite Functions |
| 33 | Inverse Functions |
|  | **P1: Differentiation** |
| 34 | The gradient of a Curve |
| 35 | Finding the Gradient of a Curve |
| 36 | Finding the Gradient from First Principles |
| 37 | Differentiating by Using Standard Results |
| 38 | Using Differentiation |
| 39 | Tangents and Normals |
| 40 | Maximum and Minimum Points |
| 41 | Increasing and Decreasing Functions |
| 42 | Points of Inflection |
| 43 | The Second Derivative |
| 44 | Applications |
| 45 | The Chain Rule |
|  | **P2: Differentiation** |
| 46 | The Product Rule |
| 47 | The Quotient Rule |
| 48 | Differentiating Natural Logarithms and Exponentials |
| 49 | Differentiating Trigonometrical Functions |
| 50 | Differentiating Functions Defined Implicitly |
| 51 | Parametric Equations |
| 52 | Parametric Differentiation |
|  | **P3: Differential Equations** |
| 53 | Forming Differential Equations from Rates of Change |
| 54 | Solving Differential Equations |
|  | **P1: Integration** |
| 55 | Reversing Differentiation |
| 56 | Finding the Area Under A Curve |
| 57 | Area as The Limit of A Sum |
| 58 | Areas Below the X Axis |
| 59 | The Area Between Tow Curves |
| 60 | The Area Between A Curve and the Y Axis |
| 61 | The Reverse Chain Rule |
| 62 | Improper Integrals |
| 63 | Finding Volumes by Integration |
|  | **P2: Integration** |
| 64 | Integrals Involving The Exponential Function |
| 65 | Integrals Involving The Natural Logarithm Function |
| 66 | Integrals Involving Trigonometrical Functions |
| 67 | Numerical Integration |
|  | **P3: Further Integration** |
| 68 | Integration by Substitution |
| 69 | Integrals Involving Exponentials and Natural Logarithms |
| 70 | Integrals Involving Trigonometrical Function |
| 71 | The Use of Partial Fractions in Integration |
| 72 | Integration by Parts |
| 73 | General Integration |
|  | **P1: Trigonometry** |
| 74 | Trigonometry Background |
| 75 | Trigonometrical Functions |
| 76 | Trigonometrical Functions for Angles of any Size |
| 77 | The sine and cosine Graphs |
| 78 | The tangent graph |
| 79 | Solving Equations using Graphs of Trigonometrical Functions |
| 80 | Circular Measure |
| 81 | The Length of An ARC of A Circle |
| 82 | The Area of A Sector of A Circle |
| 83 | Other Trigonometrical Functions |
|  | **P2: Trigonometry** |
| 84 | Reciprocal Trigonometrical Functions |
| 85 | Compound-Angle Formulae |
| 86 | Double-Angle Formulae |
| 87 | The Forms rcos, rsin |
| 88 | The General Solutions of Trigonometrical Equations |
|  | **P1: Vectors** |
| 89 | Vectors in Two Dimensions |
| 90 | Vectors in Three Dimensions |
| 91 | Vectors Calculations |
| 92 | The Angle Between Two Vectors |
|  | **P3: Vectors** |
| 93 | The Vector Equation of a Line |
| 94 | The Intersection of Two Lines |
| 95 | The Angle Between Two Lines |
| 96 | The Perpendicular Distance from A Point to a Line |
| 97 | The Vector Equation of a Plane |
| 98 | The Intersection of A Line and A Plane |
| 99 | The Distance of A Point from A Plane |
| 100 | The Angle Between A Line and A Plane |
| 101 | The Intersection of Two Planes |
|  | **P2: Logarithms and Exponentials** |
| 102 | Logarithms |
| 103 | Exponential Functions |
| 104 | Modelling Curves |
| 105 | The Natural Logarithm Functions |
| 106 | The Exponential Function |
|  | **P2: Numerical Solution of Equations** |
| 107 | Interval Estimation – Change-of-Sign Methods |
| 108 | Fixed-Point Iteration |
|  | **P3: Complex Numbers** |
| 109 | The Growth of the Number System |
| 110 | Working with Complex Numbers |
| 111 | Representing Complex Numbers Geometrically |
| 112 | Sets of Points in An Argand Diagram |
| 113 | The Modulus-Argument form of Complex Numbers |
| 114 | Sets of Points Using The Polar Form |
| 115 | Working with Complex Numbers in Polar Form |
| 116 | Complex Exponents |
| 117 | Complex Numbers and Equations |