Revised Edition

ISC COMPUTER SCIENCE

USING JAVA

BOOK II

FOR CLASS XII

Dr. DHEERAJ MEHROTRA

S. CHAND School

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ISC
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USING JAVA

FOR CLASS XII

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TO

Shruti and Shashank

With

LOVE

DEDICATED TO HONOURABLE PRESIDENT SHRI APJ ABDUL KALAM FOR BESTOWING ME THE GREAT BLESSINGS TOWARDS QUALITY OF MY WORKLIFE

On this day, September 5, 2006

PREFACE TO THE REVISED EDITION

Quality Literacy is a subordinate of QUALITY IT Literacy Today. If you are not an IT Literate, sorry to say, you are an illiterate. Kudos to Quality initiative by the Council for the Indian School Certificate Examination, (CISCE), and other boards which have introduced this part of learning as the MODE of learning other subjects in the CURRICULA. Over the years the Computer Science or the IT paper as such has been quite a supporting phase for scoring HIGH marks in the total as it is very easy to achieve 100% in the subject with a little expertise of Programming and logic as such.

I remain indebted to my Teacher Colleagues by taking an innovative step towards Quality IT Literacy today by being updated day by day with this vast field of IT learning and at the same time allows preferences over others towards QUALITY IT learning in totality. The present book titled "ISC Computer Science Using JAVA" is featured with updated syllabus guidelines and tends to provide Quality IT Literacy in the most easy way through Logic Formation and Explanations, best possible.

We are thankful to the Management Team and the Editorial Department of S. Chand & Company Ltd. for all help and support in the publication of this book. My special thanks to my wife Mrs. Yogita Mehrotra for all her delight in making my work easier and fun.

DR. DHEERAJ MEHROTRA
National Awardee

CLASS XII

There will be two papers in the subject:

Paper I: *Theory- 3 hours …100 marks*
Paper II: *Practical- 3 hours …100 marks*

PAPER I-THEORY

Paper 1 shall be of 3 hours duration and be divided into two parts.

PART I (30 MARKS):

This part will consist of compulsory short answer questions, testing knowledge, application and skills relating to the entire syllabus.

PART II (70 MARKS):

This part will be divided into three Sections, A, B and C. Candidates are required to answer ***three*** *questions out of* ***four*** *from Section A and* ***two*** *questions out of* ***three*** *in each of the Sections B and C. Each question in this part shall carry 10 marks.*

SECTION A

1. Boolean Algebra

(*a*) Propositional logic, well formed formulae, truth values and interpretation of well formed formulae (wff), truth tables, satisfiable, unsatisfiable and valid formulae. Equivalence laws and their use in simplifying wffs.

(*b*) Binary valued quantities; basic postulates of Boolean algebra; operations AND, OR and NOT; truth tables.

(*c*) Basic theorems of Boolean algebra (e.g. Duality, idempotence, commutativity, associativity, distributivity, operations with 0 and 1, complements, absorption, involution); De Morgan's theorem and its applications; reducing Boolean expressions to sum of products and product of sums forms; Karnaugh maps (up to four variables).

2. Computer Hardware

(*a*) Elementary logic gates (NOT, AND, OR, NAND, NOR, XOR, XNOR) and their use in circuits.

(*b*) Applications of Boolean algebra and logic gates to half adders, full adders, encoders, decoders, multiplexers, NAND, NOR as universal gates.

SECTION B

The programming element in the syllabus (Sections B and C) is aimed at algorithmic problem solving and **not** merely rote learning of Java syntax. The Java version used should be 1.5 or later. For programming, the students can use any text editor and the javac and java programs or any development environment: for example, BlueJ, Eclipse, NetBeans etc. BlueJ is strongly recommended for its simplicity, ease of use and because it is very well suited for an 'objects first' approach.

3. Implementation of algorithms to solve problems

The students are required to do lab assignments in the computer lab concurrently with the lectures. Programming assignments should be done such that each major topic is covered in at least one assignment. Assignment problems should be designed so that they are non-trivial and make the student do algorithm design address correctness issues, implement and execute the algorithm in Java and debug where necessary.

4. Programming in Java (Review of Class XI Sections B and C)

5. Object

(*a*) Objects as data (attributes) + behaviour (methods or functions); object as an instance of a class. Constructors.

(*b*) Analysis of some real world programming examples in terms of objects and classes.

6. Primitive values, wrapper classes, types and casting

Primitive values and types: int, short, long, float, double, boolean, char. Corresponding wrapper classes for each primitive type. Class as type of the object. Class as mechanism for user defined types. Changing types through user defined casting and automatic type coercion for some primitive types.

7. Variables, expressions

Variables as names for values; expressions (arithmetic and logical) and their evaluation (operators, associativity, precedence). Assignment operation; difference between left hand side and right hand side of assignment.

8. Statements, scope

Statements; conditional (if, if-then-else, switch-break, ?: ternary operator), looping (for, while-do, do-while, continue, break); grouping statements in blocks, scope and visibility of variables.

9. Functions

Functions/methods (as abstractions for complex user defined operations on objects), functions as mechanisms for side effects; formal arguments and actual arguments in functions; different behaviour of primitive and object arguments. Static functions and

variables. The **this** variable. Examples of algorithmic problem solving using functions (various number theoretic problems, finding roots of algebraic equations).

10. Arrays, strings

(*a*) Structured data types – arrays (single and multi-dimensional), strings. Example algorithms that use structured data types (e.g. searching, finding maximum/minimum, sorting, solving systems of linear equations, substring, concatenation, length, access to char in string, etc.).

(*b*) Basic concept of a virtual machine; Java virtual machine; compilation and execution of Java programs (the javac and java programs).

(*c*) Compile time and run time errors; basic concept of an exception, the Exception class, catch and throw.

(*d*) Class as a contract; separating implementation from interface; encapsulation; private and public.

(*e*) Interfaces in Java; implementing interfaces through a class; interfaces for user defined implementation of behaviour.

(*f*) Basic input/output using Scanner and Printer classes from JDK; files and their representation using the File class, file input/output; input/output exceptions. Tokens in an input stream, concept of whitespace, extracting tokens from an input stream (StringTokenizer class).

(*g*) Concept of recursion, simple recursive functions (e.g. factorial, GCD, binary search, conversion of representations of numbers between different bases).

SECTION C

Inheritance, polymorphism, data structures, computational complexity

11. Inheritance and polymorphism

Inheritance; base and derived classes; member access in derived classes; redefinition of variables and functions in subclasses; abstract classes; class Object; protected visibility. Subclass polymorphism and dynamic binding.

12. Data structures

(*a*) Basic data structures (stack, queue, dequeue); implementation directly through classes; definition through an interface and multiple implementations by implementing the interface. Basic algorithms using the above data structures.

(*b*) Recursive data structures: Single linked, list (Algorithm and programming), binary trees, tree traversals (conceptual).

13. Complexity and big O notation

Concrete computational complexity; concept of input size; estimating complexity in terms of functions; importance of dominant term; best, average and worst case. Big O notation for computational complexity; analysis of complexity of example algorithms using the big O notation (e.g. Various searching and sorting algorithms, algorithm for solution of linear equations etc.).

PAPER II - PRACTICAL

This paper of three hours duration will be evaluated by the Visiting Examiner appointed locally and approved by the Council. The paper shall consist of three programming problems from which a candidate has to attempt any one.

The practical consists of the two parts:

(1) Planning Session

(2) Examination Session

The total time to be spent on the Planning session and the Examination session is three hours. After completing the Planning session the candidates may begin with the Examination session. A maximum of 90 minutes is permitted for the Planning session. However, if the candidates finish earlier, they are to be permitted to begin with the Examination session.

Planning Session

The candidates will be required to prepare an algorithm and a hand written Java program to solve the problem.

Examination Session

The program handed in at the end of the Planning session shall be returned to the candidates. The candidates will be required to key-in and execute the Java program on seen and unseen inputs individually on the Computer and show execution to the Visiting Examiner. A printout of the program listing including output results should be attached to the answer script containing the algorithm and handwritten program. This should be returned to the examiner. The program should be sufficiently documented so that the algorithm, representation and development process is clear from reading the program. Large differences between the planned program and the printout will result in loss of marks.

Teachers should maintain a record of all the assignments done as part of the practical work through the year and give it due credit at the time of cumulative evaluation at the end of the year. Students are expected to do a **minimum** of twenty assignments for the year.

Marks (out of a total of 100) should be distributed as given below:

Continuous Evaluation

Candidates will be required to submit a work file containing the practical work related to programming assignments done during the year.

Programming assignments done throughout the year

(Internal evaluation) - 10 marks

Programming assignments done throughout the year

(Visiting Examiner) - 10 marks

Terminal Evaluation

Solution to programming problem on the computer - 60 marks

(Marks should be given for choice of algorithm and implementation strategy, documentation, correct output on known inputs mentioned in the question paper, correct output for unknown inputs available only to the examiner.)

Viva-voce - 20 marks

(Viva-voce includes questions on the following aspects of the problem attempted by the student: the algorithm and implementation strategy, documentation, correctness, alternative algorithms or implementations. Questions should be confined largely to the problem the student has attempted).

CONTENTS

SECTION A

SECTION B

SECTION C

SECTION D

1

BOOLEAN ALGEBRA

Syllabus:

(*a*) *Propositional logic, well formed formulae, truth values and interpretation of well formed formulae (wff), truth tables, satisfiable, unsatisfiable and valid formulae. Equivalence laws and their use in simplifying wffs.*

(*b*) *Binary valued quantities; basic postulates of Boolean algebra; operations AND, OR and NOT; truth tables.*

(*c*) *Basic theorems of Boolean algebra (e.g. Duality, idempotence, commutativity, associativity, distributivity, operations with 0 and 1, complements, absorption, involution); De Morgan's theorem and its applications; reducing Boolean expressions to sum of products and product of sums forms; Karnaugh maps (up to four variables).*

The Boolean Algebra is a two state algebra. It enables to transform logical statement into mathematical symbols, and deals in definition of relationships among proposition so as to make it possible to find out the truthfulness.

In computers, it gives a method to express the continuity of the state of flow of current through a combination of switches. The circuit which is composed of logical elements for a specific operation is called a switching circuit. With the concept of switching circuits being similar to logic circuit, it is widely implemented in the designing of the present day computer. The basic functions of the arithmetic and control units of the machine (computer) are executed through circuit containing different combinations of gates. Each accepts, inputs and outputs in the form of pulses, (1 indicates a pulse and 0 indicates no pulse). A truth table is a table which has columns for the input operands and the output operands. They are used extensively in proving for the boolean postulates and theorems.

PROPOSITIONAL LOGIC

It is an elementary statement that may either be true (1) or false (0). It can never take any other value. They may be referred as sentences or statements eg. *She is sleeping.*

It is a proposition as it can be either *True* or *False*.

eg. *Where are you going.* It is not a proposition as it does not result in *True* or *False*.

An *Operator* like (*And,* Or, *Not*) may be used to join the simple propositions to make a COMPOUND proposition.

TYPES OF PROPOSITIONAL OPERATORS :

(a) Disjunctive Operator (OR):

It is represented by the simbol '+' or '$\vee$'. It means if either or BOTH the inputs are true, the output shall also be *true* and false in other cases.

eg. A : I will opt for maths stream.

B : I will opt for computer stream.

Expression	Meaning
A + B	Either I will opt for maths or computers or both.

(b) Conjunctive operator (AND).

It is represented by the symbol '.' or '^' or '&'. When all the inputs are true (,) the output is true otherwise false (0).

eg.

A : I will opt for Maths stream.

B : I will opt for computer stream.

Expression	Meaning
A . B	I will opt for both math stream and computer stream.

(c) Conditional (If - then or Implication)

It is represented by the symbol $\Rightarrow$

ov $\rightarrow$ or >. It is explained as if one input is true and the other in false then the output is false otherwise output is true.

eg. A : I will opt for maths stream.

B : I will not opt for Biotechnology.

Expression	Meaning
A $\Rightarrow$ B	If I opt for Maths stream then I will not opt for Biotechnology.

(d) Equivalence (If and only if or Biconditional)

It is represented by the symbol $\Leftrightarrow$

Biconditional is explained as – If both the input are true or both are false the output is true otherwise the output is false.

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