

INFORMATICS PRACTICES



11149

TEXTBOOK FOR CLASS XI



विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

First Edition*August 2019 Shravana 1941***Reprinted***June 2021 Ashadha 1943***PD 30T BS****© National Council of Educational
Research and Training, 2019****₹ 140.00***Printed on 80 GSM paper with NCERT
watermark*

Published at the Publication Division
by the Secretary, National Council
of Educational Research and
Training, Sri Aurobindo Marg,
New Delhi 110016 and printed at
Sagar Offset Printer India (P.) Ltd.,
518, Ecotech III, Udyog Kendra II,
G.B. Nagar, Greater Noida (U.P.)

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 publisher.
- ❑ This book is sold subject to the condition that it shall not, by way of trade, be lent, re-sold, hired out or otherwise disposed of without the publisher's consent, in any form of binding or cover other than that in which it is published.
- ❑ The correct price of this publication is the price printed on this page. Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

OFFICES OF THE PUBLICATION**DIVISION, NCERT**

NCERT Campus

Sri Aurobindo Marg

New Delhi 110 016**Phone : 011-26562708**

108, 100 Feet Road

Hosdakere Halli Extension

Banashankari III Stage

Bengaluru 560 085**Phone : 080-26725740**

Navjivan Trust Building

P.O.Navjivan

Ahmedabad 380 014**Phone : 079-27541446**

CWC Campus

Opp. Dhankal Bus Stop

Panihati

Kolkata 700 114**Phone : 033-25530454**

CWC Complex

Maligaon

Guwahati 781 021**Phone : 0361-2674869****Publication Team**

Head, Publication : *Anup Kumar Rajput*
Division

Chief Editor : *Shveta Uppal*

Chief Production Officer : *Arun Chitkara*

Chief Business Manager : *Vipin Dewan*

Editor : *Bijnan Sutar*

Production Officer : *A.M. Vinod Kumar*

Cover Design and Layout

Meetu Sharma (Contractul)



FOREWORD

Information Technology has continuously been crossing the barriers of access and communication and reaching more and more people. The number of internet users in India has been on the rise. The tremendous growth in computer science, telecommunications and information technology has resulted in automation of various tasks and contributed to the ease of living. Technology has made continuous inroads into diverse areas—be it business, commerce, science, sports, health, transportation or education. Today, we are living in an interconnected world where computer based applications influence the way we learn, communicate, commute, or even socialise.

With so many users of information and communication technology (ICT), huge volumes of data are continuously generated at an unprecedented rate. Many innovative business models are being evolved which utilise such data to reach potential customers in a more targeted way. Government agencies are also using data to deliver services and fast track progress of different programmes, strengthen accountability and to make more informed decisions. This has been creating better opportunities for our youth not only to enter the field of technical education but also in the world of work. NCERT, for the first time, has developed a textbook on 'Informative Practices' to develop skill sets in students to make use of the opportunities provided by ICT.

This book focuses on the fundamental concepts related to handling of data while opening a window to the emerging areas of data processing. It seeks to address the dual challenges of reducing curricular load as well as introducing the latest development in the field of ICT.

As an organisation committed to systemic reforms and continuous improvement in the quality of its curricular material, NCERT welcomes comments and suggestions to enable us to bring about necessary changes in its further publications.

New Delhi
July 2019

HRUSHIKESH SENAPATY
Director
National Council of Educational
Research and Training

© NCERT
not to be republished



PREFACE

In the present education system of our country, specialised/discipline based courses are introduced at the higher secondary stage. This stage is crucial as well as challenging because of the transition from general to discipline-based curriculum. The syllabus at this stage needs to have sufficient rigour and depth while remaining mindful of the comprehension level of the learners. Further, the textbook should not be heavily loaded with content.

We are living in an era where information drives many of our socio-economic decisions. Millions of people are accessing internet round the clock for availing various services and thereby generating vast amount of data. Processing of data is becoming a key skill with applications across the disciplines. Thus, study of basic concepts of data handling and analysis is becoming more and more desirable. There are courses offered in the name of computer science, Information and Communication Technology (ICT), Information Technology (IT), etc. by various boards and schools up to the secondary stage, as an optional subject. These mainly focus on using computer for word processing, presentation tools and application software.

Informatics Practices (IP) at the higher secondary stage of school education is also offered as an optional subject. At this stage, students can take up IP with the aim of pursuing a career in data science or related areas after going through professional courses at higher levels. Therefore, at the higher secondary stage, the curriculum of IP introduces the basics of database management systems and data processing. The book has eight chapters covering the following broader themes:

- Basic understanding of computer systems and their evolution, introduction to software and their categorisation, computer memory, awareness of emerging trends in the field of information and communication technology.
- Basic constructs of a program using Python programming language — program structure, identifiers, variables, flow of control, advanced data types like Lists and Dictionaries.
- Handling data using specialised Python library called NumPy — concept of single and multi-dimensional Array.
- Concepts of data, database, and relational database management system using MySQL. Structured query language — data definition, data manipulation and data querying.

Python programming language and NumPy are introduced using both the interactive and script mode. A number of hands-on examples are given in Python, NumPy and MySQL to gradually explain the methodology to solve different types of problems and handle data. The programming and database related examples as well as the exercises in those chapters are required to be solved in a computer and verified with the given outputs.

The chapters in this book have two additional components — activities for self assessment and ‘think and reflect’ to generate further interest in the learner.

Group projects through case studies are proposed to solve complex problems. Some exercises have been made in case-study form to promote problem-finding and problem-solving skills.

These chapters have been written by involving practicing teachers as well as subject experts. These have been iteratively peer-reviewed. Several iterations have resulted into this book. Thanks to the authors and reviewers for their valuable contribution.

Comments and suggestions are welcome to make this endeavour par excellence.

Dr. Rejaul Karim Barbhuiya
Assistant Professor,
Department of Education in
Science and Mathematics, NCERT



TEXTBOOK DEVELOPMENT COMMITTEE

MEMBERS

Anuradha Khattar, *Assistant Professor*, Miranda House, University of Delhi, Delhi

Chetna Khanna, *Freelance Educationist*, Delhi

Gurpreet Kaur, *PGT (Computer Science)*, GD Goenka Public School, Delhi

Harita Ahuja, *Assistant Professor*, Acharya Narendra Dev College, University of Delhi, Delhi

Mudasir Wani, *Assistant Professor*, Govt. Degree College for Women, Srinagar, Jammu and Kashmir

Om Vikas, *Professor (Retd.)*, Formerly Director, ABV-IIITM, Gwalior, Madhya Pradesh

Priti Rai Jain, *Assistant Professor*, Miranda House, University of Delhi, Delhi

Rinku Kumari, *PGT (Computer Science)*, Kendriya Vidyalaya, Sainik Vihar, Delhi

Sharanjit Kaur, *Associate Professor*, Acharya Narendra Dev College, University of Delhi, Delhi

Tapasi Ray, *Formerly Global IT Director*, Huntsman Corporation, Singapore

MEMBER-COORDINATOR

Rejaul Karim Barbhuiya, *Assistant Professor*, DESM, NCERT, Delhi

ACKNOWLEDGEMENTS

The National Council of Educational Research and Training acknowledges the valuable contributions of the individuals and organisation involved in the development of Informatics Practices textbook for Class XI.

The council expresses its gratitude to the syllabus development team including MPS Bhatia, *Professor*, Netaji Subhas Institute of Technology, Delhi; T V Vijay Kumar, *Professor*, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi; Zahid Raza, *Associate Professor*, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi; Vipul Shah, *Principal Scientist*, Tata Consultancy Services, and the CSpathshala team; Smruti Ranjan Sarangi, *Associate Professor*, Department of Computer Science and Engineering, Indian Institute of Technology Delhi; Vikram Goyal, *Associate Professor*, Indraprastha Institute of Information Technology (IIIT) Delhi; Vandana Tyagi, *PGT (Computer Science)*, Kendriya Vidyalaya, JNU, Delhi and Mamur Ali, *Assistant Professor*, Central Institute of Educational Technology, NCERT, New Delhi.

The council is thankful to the following resource persons for their contribution in editing, reviewing, and refining the manuscript of this book: D.N. Sansanwal, *Retd. Professor*, Devi Ahilya Vishwavidyalaya, Indore; Veer Saini Dixit, *Assistant Professor*, Atma Ram Sanatan Dharma College, University of Delhi, Delhi; Mukesh Kumar, *Teacher*, DPS RK Puram, Delhi; Gautam Sarkar, *Teacher*, Modern School, Barakhamba Road, Delhi; Aswin K. Dash, *Teacher*, Mother's International School, Delhi; Nancy Sehgal, *Teacher*, Mata Jai Kaur Public School, Delhi; Neelima Gupta, *Professor*, Department of Computer Science, University of Delhi; Anamika Gupta, *Assistant Professor*, Shaheed Sukhdev College of Business Studies, University of Delhi. The council further acknowledges the contribution of Anuja Krishn, *freelance editor*, for refining the chapters from language point of view.

The council is grateful to Dinesh Kumar, *Professor and Head*, DESM for his valuable cooperation and support throughout the development of this book.

The council also gratefully acknowledges the contributions of Meetu Sharma, *Graphic Designer*; Kanika Walecha, *DTP Operator*; Pooja, *Junior Project Fellow*; Hari Darshan Lodhi and Junaid Ahmed, *DTP Operator (Contractual)*; Chanchal Chauhan, *Proofreader (Contractual)* and Aishwarya Bhattacharyya, *Assistant Editor (Contractual)*, in shaping this book. The contributions of the office of the APC, DESM and Publication Division, NCERT, New Delhi, in bringing out this book are also duly acknowledged.



CONTENTS

FOREWORD	iii
PREFACE	iv
CHAPTER 1 COMPUTER SYSTEM	1
1.1 Introduction to Computer System	1
1.2 Evolution of Computer	3
1.3 Computer Memory	5
1.4 Software	9
CHAPTER 2 EMERGING TRENDS	15
2.1 Introduction to Emerging Trends	15
2.2 Artificial Intelligence (AI)	16
2.3 Big Data	19
2.4 Internet of Things (IoT)	21
2.5 Cloud Computing	23
2.6 Grid Computing	25
2.7 Blockchains	26
CHAPTER 3 BRIEF OVERVIEW OF PYTHON	31
3.1 Introduction to Python	31
3.2 Python Keywords	34
3.3 Identifiers	34
3.4 Variables	34
3.5 Data Types	35
3.6 Operators	38
3.7 Expressions	41
3.8 Input and Output	42
3.9 Debugging	43
3.10 Functions	44
3.11 if..else Statements	46
3.12 for Loop	48
3.13 Nested Loops	50
CHAPTER 4 WORKING WITH LISTS AND DICTIONARIES	55
4.1 Introduction to List	55
4.2 List Operations	57
4.3 Traversing a List	59
4.4 List Methods and Built-in Functions	60

4.5	List Manipulation	62
4.6	Introduction to Dictionaries	67
4.7	Traversing a Dictionary	69
4.8	Dictionary Methods and Built-in Functions	69
4.9	Manipulating Dictionaries	71
CHAPTER 5	UNDERSTANDING DATA	81
5.1	Introduction to Data	81
5.2	Data Collection	85
5.3	Data Storage	86
5.4	Data Processing	87
5.5	Statistical Techniques for Data Processing	88
CHAPTER 6	INTRODUCTION TO NUMPY	95
6.1	Introduction	95
6.2	Array	96
6.3	NumPy Array	96
6.4	Indexing and Slicing	100
6.5	Operations on Arrays	102
6.6	Concatenating Arrays	104
6.7	Reshaping Arrays	105
6.8	Splitting Arrays	106
6.9	Statistical Operations on Arrays	107
6.10	Loading Arrays from Files	109
6.11	Saving NumPy Arrays in Files on Disk	112
CHAPTER 7	DATABASE CONCEPTS	123
7.1	Introduction	123
7.2	File System	124
7.3	Database Management System	127
7.4	Relational Data Model	132
7.5	Keys in a Relational Database	136
CHAPTER 8	INTRODUCTION TO STRUCTURED QUERY LANGUAGE (SQL)	143
8.1	Introduction	143
8.2	Structured Query Language (SQL)	144
8.3	Data Types and Constraints in MySQL	145
8.4	SQL for Data Definition	146
8.5	SQL for Data Manipulation	153
8.6	SQL for Data Query	156
8.7	Data Updation and Deletion	166