

INFORMATICS PRACTICES

TEXTBOOK FOR CLASS XII



12149

© NCERT
not to be republished

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

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

ISBN 978-93-5292-361-8

First Edition

December 2020 Agrahayana 1942

PD 50T BS

© **National Council of
Educational Research and
Training, 2020**

₹ 130.00

Printed on 80 GSM paper

Published at the Publication Division
by the Secretary, National Council of
Educational Research and Training,
Sri Aurobindo Marg, New Delhi
110 016 and printed at Nikhil
Offset, 223, 127, DSIDC Complex,
Okhla Industrial Area, Phase-I, New
Delhi-110 020

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 Division : Anup Kumar Rajput
Chief Editor : Shveta Uppal
Chief Production Officer : Arun Chitkara
Chief Business Manager (In charge) : Vipin Dewan
Editor : Bijan Sutar
Assistant Production Officer : Mukesh Gaur

Cover and Layout

DTP Cell, Publication Division



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 'Informatics 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.

HRUSHIKESH SENAPATY

Director

New Delhi
August 2020

National Council of Educational
Research and Training

© NCERT
not to be republished



PREFACE

In the present education system of our country, specialised and 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 secondary stage, as optional. 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 higher secondary stage, the curriculum of IP introduces basics of database management systems and data processing. The book has seven chapters covering the following broader themes:

- **SQL Queries:** Querying database using the Structured Query Language by applying SQL functions including aggregate functions.
- **Data Handling:** The popular Python library called Pandas has been introduced. The important data structures of Pandas – Series and DataFrame have been covered in details and basic data handling and data analysis using Pandas are included.
- **Data Visualisation:** The Pandas library called Pyplot is introduced. It demonstrates how to generate high quality graphs and charts from Python using the Pyplot tool.
- **Internet and Web:** Introduction to the concepts of Computer networks are given, followed by a brief overview of Internet, its application are given. The concept of web, website, and its hosting is also included.
- **Societal Impact:** Awareness of digital footprints, data privacy and protection, cyber crime, etiquettes, copyright and plagiarism, E-waste in a digital society and their implications on security, privacy, piracy, ethics, values and health concerns.

Each chapter has two additional components — (i) activities and (ii) think and reflect for self assessment while learning as well as to generate further interest in the learner. A number of hands-on examples are given to gradually explain methodology to solve different types of problems across the Chapters. The programming examples as well as the exercises in the chapters are required to be solved in a computer and verify with the given outputs.

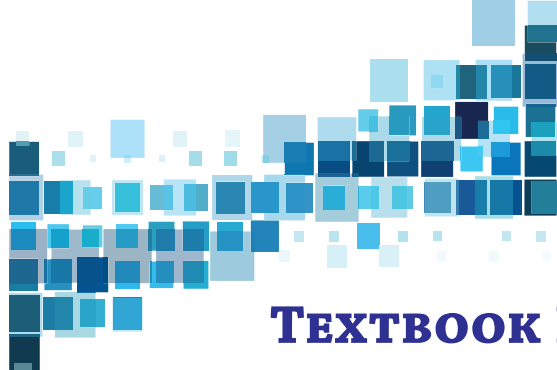
Box items are pinned inside the chapters either to explain related concepts or to describe additional information related to the topic covered in that section. However, these box-items are not to be assessed through examinations.

Project Based Learning given at the end includes exemplar projects related to real-world problems. Teachers are supposed to assign these or similar projects to be developed in groups. Working in such projects may promote peer-learning, team spirit and responsiveness.

The chapters have been written by involving practicing teachers as well as subject experts. Several iterations have resulted into this book. Thanks are due to the authors and reviewers for their valuable contribution. I would like to place on record appreciation for *Professor Om Vikas* for leading the review activities of the book as well as for his guidance and motivation to the development team throughout. Comments and suggestions are welcome.

New Delhi
31 August 2020

Dr. Rejaul Karim Barbhuiya
Assistant Professor
Central Institute of
Educational Technology



TEXTBOOK DEVELOPMENT COMMITTEE

MEMBERS

Anamika Gupta, *Assistant Professor*, Shaheed Sukhdev College of Business Studies, University of Delhi

Anju Gupta, *Freelance Educationist*, Delhi

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

Chetna Khanna, *Freelance Educationist*, Delhi

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

Mohini Arora, *HOD (Computer Science)*, Air Force Golden Jubilee Institute, Subroto Park, Delhi

Naeem Ahmad, *Assistant Professor*, Madanapalle Institute of Technology and Science, Madanapalle, Andhra Pradesh

Naveen Gupta, *PGT (Computer Science)*, St. Marks's Sr Sec Public School, Meera Bagh, Delhi

Neeru Mittal, *PGT (Computer Science)*, SRDAV Public School, Dayanand Vihar, Delhi

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

Sangita Chadha, *HOD (Computer Science)*, Ambience Public School, Safdarjung Enclave, Delhi

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

Sugandha Gupta, *Assistant Professor*, Sri Guru Gobind Singh College of Commerce, University of Delhi

Vineeta Garg, *PGT (Computer Science)*, SRDAV Public School, Dayanand Vihar, Delhi

MEMBER-COORDINATOR

Rejaul Karim Barbhuiya, *Assistant Professor*, Central Institute of Educational Technology, NCERT, Delhi



ACKNOWLEDGEMENTS

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

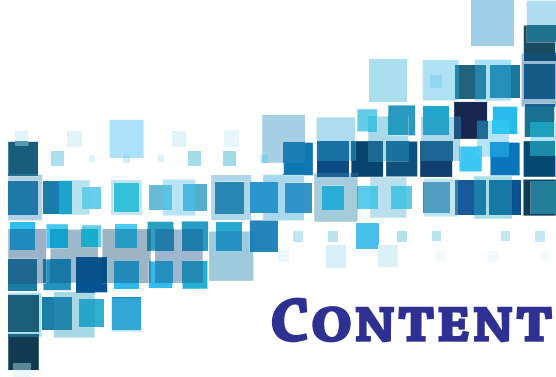
The Council expresses its gratitude to the syllabus development team including MPS Bhatia, *Professor*, Netaji Subhas Institute of Technology, Delhi; T. V. Vijay Kumar, *Professor*, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi; Zahid Raza, *Associate Professor*, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi; Vipul Shah, *Principal Scientist*, Tata Consultancy Services, and the CSpathshala team; Aasim Zafar, *Associate Professor*, Department of Computer Science, Aligarh Muslim University, Aligarh; Faisal Anwer, *Assistant Professor*, Department of Computer Science, Aligarh Muslim University, Aligarh; 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; and Mamur Ali, *Assistant Professor*, Department of Teacher Training and Non-formal Education (IASE), Faculty of Education, Jamia Millia Islamia, New Delhi.

The Council is thankful to the following resource persons for providing valuable inputs in developing this book — D.N. Sansanwal, *Retd. Professor*, Devi Ahilya Vishwavidyalaya, Indore; Veer Sain Dixit, *Assistant Professor*, Atma Ram Sanatan Dharma College, University of Delhi; Mukesh Kumar, DPS RK Puram, Delhi; Aswin K. Dash, Mother's International School, Delhi; Purvi Kumar, *Co-ordinator*, Computer Science Department, Ganga International School, Rohtak Road, Delhi; Mudasir Wani, *Assistant Professor*, Govt. College for Women, Nawakadal, Srinagar, Jammu and Kashmir; Sajid Yousuf Bhat, *Assistant Professor*, University of Kashmir, Jammu and Kashmir; *Professor Om Vikas, Formerly Director*, ABV-IIITM, Gwalior, MP.

The council is grateful to Sunita Farkya, *Professor and Head*, Department of Education in Science and Mathematics, NCERT and Amarendra P. Behera, *Professor and Joint Director*, CIET, NCERT for their valuable cooperation and support throughout the development of this book.

The Council also gracefully acknowledges the contributions of Meetu Sharma, *Graphic Designer cum DTP Operator*, Kanika Walecha, *DTP Operator*, Pooja, *Junior Project Fellow* 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.

The Council also acknowledges the contribution of Ankeeta Bezboruah *Assistant Editor* (Contractual), Publication Division, NCERT for copy editing this book. The efforts of Rajshree Saini, *DTP Operator* (Contractual), Publication Division, NCERT are also acknowledged.



CONTENTS

FOREWORD	iii
CHAPTER 1 QUERYING AND SQL FUNCTIONS	1
1.1 Introduction	1
1.2 Functions in SQL	4
1.3 GROUP BY in SQL	14
1.4 Operations on Relations	16
1.5 Using Two Relations in a Query	19
CHAPTER 2 DATA HANDLING USING PANDAS - I	27
2.1 Introduction to Python Libraries	27
2.2 Series	29
2.3 DataFrame	40
2.4 Importing and Exporting Data between CSV Files and DataFrames	55
2.5 Pandas Series Vs NumPy ndarray	57
CHAPTER 3 DATA HANDLING USING PANDAS - II	63
3.1 Introduction	63
3.2 Descriptive Statistics	65
3.3 Data Aggregations	75
3.4 Sorting a DataFrame	77
3.5 GROUP BY Functions	79
3.6 Altering the Index	82
3.7 Other DataFrame Operations	84
3.8 Handling Missing Values	89
3.9 Import and Export of Data between Pandas and MySQL	98
CHAPTER 4 PLOTTING DATA USING MATPLOTLIB	105
4.1 Introduction	105
4.2 Plotting using Matplotlib	106
4.3 Customisation of Plots	108
4.4 The Pandas Plot Function (Pandas Visualisation)	112

CHAPTER 5 INTERNET AND WEB	137
5.1 Introduction to Computer Networks	137
5.2 Types of Networks	139
5.3 Network Devices	142
5.4 Networking Topologies	146
5.5 The Internet	148
5.6 Applications of Internet	149
5.7 Website	153
5.8 Web Page	154
5.9 Web Server	156
5.10 Hosting of a Website	157
5.11 Browser	158
CHAPTER 6 SOCIETAL IMPACTS	167
6.1 Introduction	167
6.2 Digital Footprints	168
6.3 Digital Society and Netizen	169
6.4 Data Protection	174
6.5 Creative Commons	178
6.6 Cyber Crime	179
6.7 Indian Information Technology Act (IT Act)	182
6.8 E-waste: Hazards and Management	183
6.9 Impact on Health	186
CHAPTER 7 PROJECT BASED LEARNING	195
7.1 Introduction	195
7.2 Approaches for Solving Projects	196
7.3 Teamwork	197
7.4 Project Descriptions	199